

REPORTS

IN

OPERATIVE SURGERY.

Series the Third.



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REPORTS IN OPERATIVE SURGERY.

1. REMARKS ON "BUTCHER'S OPERATION" FOR EXCISION OF THE WRIST-JOINT AND CARPUS, ILLUSTRATED BY CASES.
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IN the British and Foreign Medico-Chirurgical Review for October, 1857, will be found a very able article "On Resection of large Joints." The subject-matter being derived from

the perusal and analysis of numerous books and essays, I subjoin in a note^a the names and titles attached to them, because they are a vast number produced within a very limited period, comprised in even so short an epoch as two years. This fact speaks of itself as a mighty evidence, confirmatory of the inquiry aroused—the interest excited by the great characteristic feature distinguishing the surgery of the day, Conservatism.

In addition to these, numerous communications, some of them of a most valuable character, upon the subject of resection as applied to the several joints, have appeared during the past year, illustrated by cases and practical observations, in “*The Medical Times and Gazette*,” “*The Lancet*,” “*The Edinburgh Monthly Journal*,” and the “*Dublin Quarterly Journal of Medical Science*,” and finally, I cannot pass over Mr. Fergusson’s *Surgery*, the recent edition of which gives a condensed and valuable epitome of this most interesting matter.

I would again call the attention of the reader to the “*Review on Resection of Large Joints*,” it will well repay a careful perusal; the trust committed to the writer’s hands has been dealt with in a comprehensive way, in a spirit of truth.

The operations at the shoulder, the elbow, and the wrist, are each made the subject of comment and observation; and, next in succession, follows the resection of the hip, the knee, and ankle-joints, treated in a similar way. I cannot but feel very deeply sensible of the high honour conferred upon myself, in having my humble efforts appreciated by the able writer,

^a On Resections and Amputations; with four lithographic plates; p. 269. By Dr. J. F. Heyfelder, Professor of Medicine at Erlangen. 1855.

Contributions on the Subject of Resections at the Foot. By Dr. Robert, of Coblenz. 1855.

Dissertation on Resection of the Shoulder and Elbow-Joints. By P. G. Kyriakos. 1854.

Dissertation on Resections of the Elbow-Joint. By Albert Tobold. 1855.

On Excision of the Knee-Joint. By R. G. H. Butcher, Esq., M. R. I. A., Surgeon to Mercer’s Hospital. *Dublin Quarterly Journal*, May, 1855, p. 66.

On Excisions of Joints. By the same Author. *Dublin Quarterly Journal*, November, 1855, p. 40.

Second Memoir on Excision of the Knee-Joint. By the same Author. *Dublin Quarterly Journal*, February, 1857, p. 70.

Cases of Operation upon Diseased Joints. By W. A. Green, M. D., Bengal Medical Service. 1855.

Gun-shot Fractures, by Dr. Stromeyer; and Resection in Gun-shot Injuries, by Dr. Esmarch, p. 120. Translated by S. F. Statham. London: 1856.

On Excision. By Surgeon Thornton, 9th Regiment. *Medical Times and Gazette*. 1856.

On Excision of the Hip-Joint. By Mr. Haneock. *Lancet*. 1857.

as given expression to in this valuable communication to surgery. In the same spirit I am sure he will bear with me for a moment, while I call attention to one of the subjects under review. I allude to excision of the wrist-joint. It is true that allusion has been made to the case of an old woman aged 58, from whom I excised the wrist-joint, and who died of cerebral effusion. I conceive, however, it should have been mentioned that the woman would not submit to amputation, and as a *dernier ressort* I was compelled to take away the source of irritation. In my paper on Excision of Joints^a it is thus expressed: "Now, so extensive was the local disease, and so fearful the constitutional symptoms evoked by its presence, that the taking away of the source of irritation was absolutely called for, so as to afford a chance of life being preserved under the circumstances. I mentioned the operation of excision, and dwelt upon its propriety, and, if rejected, as a *dernier ressort* amputation through the forearm. The woman at once made up her mind not to lose the hand, and anxiously expressed a wish that I would endeavour to save it by cutting out the diseased bones." The patient lived for seven days. And further, it is stated in my Report:—"Up to this period, the 9th" (being operated on on the 2nd of the month), "the patient seemed to be going on most satisfactorily, when suddenly symptoms of effusion in the brain came on, rapidly indeed, and without premonitory symptoms; she quickly became comatose, and died in a few hours." And further (at page 15),—"By some it may be asked, why was the character of an operation, so new in itself, risked in a case so unpromising, in a patient *so advanced in life*? My answer simply is, the patient would not submit to amputation, while she willingly agreed to the proposition of resection. The latter was, with my full approbation, acceded to. I could not bring myself, without any valid reason, to condemn the limb, and, as it were, to exclude this creature without the pale of modern surgery; and from an impartial view of the case, in all truth, I protest that the particular operation practised had no more to do with her death than as it might have occurred after simple amputation of the forearm. There was no shock; all the vital actions for days seemed well balanced; and there was no local manifestation of mischief; on the contrary, repair had rapidly advanced. The post-mortem appearances, as already mentioned, pronounce the cause of death, such as every practical surgeon must be conversant with; this sudden and

^a Dublin Quarterly Journal, November, 1855, p. 13.

rapid effusion, either into the head or chest, will sometimes frustrate his best efforts after operation in the *old* and *young*, in the latter particularly when a scrofulous taint exists." The foregoing case was headed in my paper, "Excision of the Wrist-Joint and Carpus by a new Operation," and it is most pleasing to me to learn that it has been favourably received. According to my views, we should have also included under the head "resection of large joints," excision of the carpus together with portions of the metacarpal bones, because in reality the same operative measures—at least the chief and important proceedings—are required, as if the extremity of the radius and ulna were likewise clipped or sawn away; in other words, the same cautious division and elevation of flaps, dissection out of soft parts, tendons, and avoidance of vessels, are required in either case to the perfection of the end,—the preservation of a useful hand. And, as mentioned in the Quarterly referred to, I shortly after brought this *new operation* of mine for excision of the wrist-joint to the test, when I cut out the carpus, together with the carpal ends of two of the metacarpal bones, with the most successful result. In the Number referred to, the case is fully detailed, as also the method of operation. And I shall here make a few remarks as to the present state of the man, introduce a drawing of the appearance of the hand, and likewise a *fac simile* of a letter which he wrote to me a few days since. The hand occasions no pain, and requires but little protection from external agents, being able to resist violence as well as the sound one; the contour and outline of the organ are not spoiled, nor its beauty much defaced; of course, a scar marks the course of the surgeon's knife, and the fingers are a little bent; but, in the attitude represented in the lithograph, little alteration is manifest as contrasted with the sound limb, and when relieved from this posture the motions of the thumb are so rapidly performed that it would require a very critical examination to detect any change from the normal condition and the perfection of its functions. The man has been earning an ample independence for many months back, and in an occupation where the serviceability of the member could not be dispensed with. He now fills a situation of trust, and to discharge the duties of his office it is essential he should be able to write; this he can do, quite well enough to give satisfaction. I shall not offer another word of comment; let the following exposition attest the value of the operation,—it is the lithographed letter (see Plate I.).

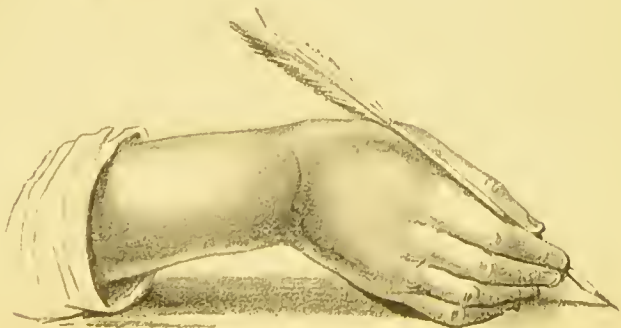
The advantages which my new operation for excision

165 Moland Place

Sir Dublin December 1st 1858

I take the liberty of addressing
the following few lines to you
for the purpose of acknowledging
my most sincere and heartfelt
thanks to you for restoring to me
the hand which some time
ago I wanted you to take off
but thanks be to God and
you is now quite well and
I am able to earn my bread
with it

I am sir your obt^d Serv^t
William Moran
Richard G. H. Butcher Esq





of the wrist-joint and carpus possesses over every other are thus expressed:—"The operation which I think best suited to those cases is the one which I put in practice myself. It meets every objection which has been urged against the measure, and to which I have already alluded. Mr. Stanley's operation is somewhat similar; but mine is superior, inasmuch as the tendons of the muscles of the thumb are not divided or disturbed from the soft tissues which immediately surround them, and are thereby protected from sloughing and death; so that all the motions of the member in its integrity can be preserved. No doubt, after excision of the wrist-joint and carpus, much motion cannot be expected; a firm fibro-ligamentous structure fills up the place of the removed bones, and fuses the surrounding textures into its dense tissue, and mats all together. But, according to my views, the hand may be retained nearly as useful as ever; the fingers being kept semi-flexed during the process of repair, they retain this position, and the thumb, being preserved perfect in its motions, readily approximates either of the fingers, so that the hand can be applied to its most delicate uses, such as writing, sewing, &c., as well as to the most severe and common-place, using implements for husbandry, grasping bodies, &c." Numerous cases bearing upon this mode of dealing with the matter are given, illustrative of its beneficial effects, in the paper already referred to, published in the *Dublin Quarterly Journal*.

I shall offer no apology for again making some comments on resection of the knee and elbow. The cases which I adduce are additional evidences of the value of this special operation; but, more than that, there are peculiarities attached to each, both in history, operation, and treatment, most interesting, I conceive, to the pathological inquirer, as well as serviceable to the practical surgeon. And first stands upon the list my third successful case of excision of the knee-joint.

CASE I.—*A third successful case of Excision of the Knee-Joint, in which the "drainage system" of Chassaignac was applied ; the first instance ; further cautions with regard to adjusting the cut parts ; recovery, with an admirable limb.*

Mary Carey, aged 15 years, admitted into Mercer's Hospital on the 4th of January, 1858. *History.*—The infliction of the injury, which was supposed to originate the disease of the knee-joint in this case, dates so far back as seven years. When the child was only eight years of age, she was thrown down by a playfellow, when returning from school, and her right knee was violently wrenched, and bruised against the curbstone of the pathway. She was supported home, and remained confined to bed and to the house for several days after. The recovery from this primary injury was slow and unsatisfactory, though the usual remedies—stuping, leeching, &c.—were employed; slow, because several days passed by with but little amendment; unsatisfactory, because a lingering pain and uneasiness, upon very trivial exertion, settled in the part. Months passed over, and years elapsed, and upon various occasions accessions of suffering were aroused, and were again quieted and subdued by surgical interference, both when in her attendance as an external patient at several hospitals, and more particularly while an internal recipient of their advantages. Still the disease progressed up to the date which I have recorded of her admission into Mercer's Hospital under my care. A glance at the patient told the sad tale, that a corroding cause was hastily sapping the springs of life. A few words, a cursory examination, pointed to the source. The very attitude of the patient betokened the part. As she sat upon the bed, the thigh was flexed, the leg could not be extended, but the foot rested steadily upon its sole, and guardedly did the sufferer, with both attenuated hands, steady it in this position, so as to prevent any wabbling or lateral motion. The outline of the extremity, as it thus rested, showed not only the wasted condition of the member, but likewise very clearly the distorted condition of the knee-joint. The projecting condyles of the femur were tilted upwards; while it was equally apparent that the tibia had receded, or, in other words, was drawn backwards into the popliteal space. The natural contour of the joint was lost; it was squared in front; and this arose from the puffed out and thickened synovial membrane at either side of the ligamentum patellæ. The distortion of the limb was rendered greater from the fact that where the tibia passed backwards, it was, together with the foot, rotated outwards. There

were no sinuses or breach of the integuments surrounding the joint; neither was there much discoloration at any point. The extreme rotation of the leg outwards, the displacement of it backwards, pointed to that condition of the interior of the joint which permitted so extensively such misapplication of the articular surfaces of the bones—the total disintegration of its fibrous connexions, check ligaments, &c. On the slightest manipulation this state of parts was confirmed, for the leg could be moved in one direction, and the thigh in another, each being grasped by the right and left hand of the surgeon. An antero-posterior motion of one bone upon the other could likewise be demonstrated by altering the forces. None of these efforts could be even attempted without the greatest apprehension, as depicted in the terror of the patient; and a realization of the extent of such motion could not be effected without loud and prolonged screams of suffering. Resulting from such an examination, the grating of the carious bones one upon the other afforded unmistakeable evidence of the widespread and destructive implication of the articular surfaces. The popliteal space was filled by the displaced tibia, but far lower, and beneath, projected the strained hamstrings, tense, firm, and unyielding, rigorously preserving their spastic contraction. There was full evidence, too, of the synovial membrane of the walls of the joint having undergone total change: it was thickened, elastic, puffy at either lateral boundary of the patella, giving an indistinct sense of fluctuation, most deceptive as to the presence of matter, but sufficiently characterised by a peculiar resiliency, at once recognisable from suppurative accumulations by the educated touch. The prominence of the outer wall considerably exceeded that of the inner, and over this locality, too, the tenderness upon pressure was most manifest. Consequent upon the presence of this very extensive local change, the health of the creature was greatly broken up; pain, in a subdued form, was never absent for many months, and at some times was of the most excruciating nature; as described by the patient, “often a boring, burning pain made her scream out in distress.” Her sufferings were always increased by any motion of the parts, and the repeated startings, and spasms, and cramps of the entire limb occasioned watchful nights, unwearied restlessness, and apprehension, with, frequently for successive hours, the total absence of sleep. Healthy digestion was entirely interfered with; the appetite gone; there was great emaciation present, and a bewildered look of excitement and fear was stamped upon the countenance; age, far beyond the years of the child, was stereotyped there. Irritation had

done its worst, and hectic followed upon its ravages, marked by an accelerated and rapid circulation, frequent attacks of diarrhœa, chills and burning, and profuse sweating. These reduced the sufferer to that condition which compelled her friends to bring her to hospital, and willingly submit her to any mode of treatment that might be considered requisite to save her life. In this state, then, she was admitted under my care, and certainly no combination of symptoms could have presented a more unpromising result.

Upon instituting the most careful investigation of every fact in relation with the case, at the same time making the most cautious examination of the diseased joint, as to extent of bone disease, the implication of parts around, &c., and, above all, the condition of vital organs, as far as in my power lay, I came to this decision—the propriety of excising the joint. There were no sinuses, there was no breach of surface by which the aid of the probe could be brought into requisition. The inference as to the propriety of the measure was arrived at from the combined local and constitutional evidence already alluded to.

On the 11th of January I excised the joint, adopting the H incision; quickly the soft parts were divided and reflected, and cautiously they were freed from the bones behind. The ligamentous structures within the joint, the cartilages of incrustation of the three bones, were entirely removed, and the contiguous surfaces of the bones most extensively destroyed. The condyles of the femur were hollowed out and eaten away to about an inch in extent, while the surface of the tibia was also deeply excavated, corresponding to each condyle, the intervening part being irregularly removed; the patella was also deeply carious, hence I removed it at once from the upper flap. The diseased extremity of the femur was cut with the saw invented by myself, and the section made from behind forwards; and so likewise the unhealthy surface of the tibia. The section of the femur revealed a beautifully healthy aspect, while the section of the tibia showed a softened irregular patch, about the size of a shilling, with a vascular fringe running round its confines, and separating it from the healthy bone outside. This appearance occasioned me to cut off another slice from the tibia, somewhat more than a quarter of an inch in thickness, and the section exposed a perfectly healthy condition, the normal arrangement of the bone. In all, there were about three-quarters of an inch or a little more of the tibia removed, and an inch and a half of the femur. The divided blood-vessels were small; no ligatures were required; and I at

once placed the limb in the extended position, resting upon its posterior surface in the apparatus which bears my name. Let it be borne in mind, that previous to the operation the leg was considerably flexed, and the hamstrings rigidly contracted. This condition offered serious opposition to the required posture at first, but by gentle, steady, and gradually increased force, they were compelled to yield. Now, in the adjustment of the bones, there is one practical point which I have not before alluded to, neither is it noticed, so far as I am aware, by any writer on this subject; namely, the caution that is requisite, when straightening the limb, *to guard against any portion of the soft parts behind projecting forwards, and thus interposing between the bones.* Such an occurrence took place in this instance during my first efforts to get the limb into a horizontal posture, but I perceived and rectified it at once; however, it might be easily overlooked, and I have no doubt would interfere in a very material manner with the firm union of the bones, or their growth into each other—a consummation so ardently sought for in these cases. Now this untoward circumstance may be guarded against by the following manœuvre: namely, to adjust accurately, while the leg is yet flexed, the posterior margin of the cut surfaces of the tibia and femur, and while the sharp edge of one rests upon that of the other, the tibia and femur are gently forced backwards until the opposed surfaces rest fairly against each other. During this manipulation, then, the bones are pressed up firmly against each other, as well as with an equal force backwards. By this precaution the interposition of any softened structure will be effectually prevented. After this manner, then, the bones were fairly applied to each other, and afterwards the flaps laid down. They were brought together throughout the transverse incision by a few points of the interrupted suture, while some folds of lint were laid in the lateral ones, the object being two-fold: first, to prevent any immediate flow of blood; and secondly, at a later period, to permit a free escape from the part, so that purulent matter should not be pent up; the front splint was laid down, and each side of the box was then lifted, and an additional compress of lint placed over the wound at either side, so that an even, equable support was given, maintained. During this entire adjustment, from first to last, the leg was pressed up against the thigh; and, to secure it in this position, the foot-board slid into the grooves for its reception was most efficient, steadying the foot also at a right angle with the leg. An additional pad, wedge-shaped, was placed at the outer ankle, and projecting upwards, so as to maintain the

foot in a straight line, and prevent any drooping outwards or eversion. The straps were then buckled round the box, and the patient, still under the influence of ehloroform, removed earefully to bed. She, however, quickly awoke from her sleep, quite unaware that the operation had been performed.

I have not eonsidered it necessary to dwell at any length upon the various steps of this operation; the various ways in which the flaps may be made, or the extent to which the knife should be used; the advantages of sawing the bones from behind forwards, and espeecially their line of section with the instrument bearing my name; the benefits arising from at once plaecing the limb in position; the modes of dealing by subeutaneous section with the hamstrings in partieular eases; the speecial benefits which arise from the adoption of my meehanical appliance in the after management of the limb, from first to last, if I may so express myself, from the section of the bones to their final growing into each other, or permanent union;—these several questions have been all most thoughtfully eonsidered in the several memoirs and papers which I have written upon this speecial operation in the past Numbers of this Journal^a. Immediately after eonsciousness was restored, the patient vomited freely; by no means an unusual eonsequeene after the inhalation of ehloroform. She got wine and opium at intervals, which soon quieted the stomach, and about 4 o'elock she fell into a quiet sleep.

9 P.M. In the later part of the day she took a eupful of beef-tea, which staid upon the stomach; opium and wine to be eontinued through the night. She does not eomplain of pain in the limb, and it rests quite undisturbed.

January 12th. Through the night she had oeasional twitches of pain, but not sueffieient to prevent sleep; indeed, the repetition of the opium invariably quieted the threatenings of suffering; the wine was also taken steadily; the limb lay just as when put up. There was some slight œdema of the leg, evidently produced by the undue pressure exerted upon the lateral aspects of the knee by the additional eompresses in the longitudinal wounds, and the pressure from before exerted by the anterior splint; yet there was no constitutional annoyance or loeal distress sueffieient to call for any interference with the meehanical restraint.

Early even as this day, we had signally marked the beneficial effects of the operation. Unmistakeable evidence was afforded by the lowering of the pulse; the total arrest of night-

^a Dublin Quarterly Journal, February, 1855; February, 1857; November, 1857.

sweats. Hunter noticed this great evidence of the calm induced by appropriate amputation, when great irritation, sensitiveness, and fever, signalized the presence of a joint irreparably seized upon by disease; and the aphorism of this great man remains the same now as when penned or first given to the world.

13th. She slept almost uninterruptedly; no startings of the limb, or nervous apprehensions about the patient to-day; she is quite cheerful; the tongue is cleaning; the urine in full quantities; the pulse only 90, steady, and with good volume; took some toast and tea; the leg is not more swollen; transverse wound puffed, and at the lateral extremities of it purulent matter and serum are escaping freely. To have beef-tea and wine freely, and ten drops of opium every fourth hour.

14th. She slept well and quietly, the opium being continued through the night, beef-tea and wine also being given. On this morning I placed the patient under chloroform, to examine the parts and partially dress the wounds. The advantage of doing so was very apparent, because, from the quietude imposed, all chance of displacement of the bones was guarded against when the mechanical restraint was slackened off; again it acted most beneficially in preventing that exhaustion necessarily induced by the struggles of a patient suffering under acute pain. The outer side of the box was first let down,—the internal side, the limb, the foot-board, and front splint being carefully steadied in one piece, as it were. I cautiously separated the pledget of lint placed over the external incision, and, there being no oozing of blood, the side support was elevated. With similar precautions the internal side of the box was let down, and the inner wound dressed; a part of the compress was adherent in the wound; so much was permitted to remain, and all the rest cut away—a measure far preferable to having recourse to that violence necessary for its separation. It may be said, why not soften it with water, and detach it with gentleness. I did not think such efforts advisable, because, if hemorrhage was brought on in any degree, the means necessary for its suppression might have risked the quietude of the limb, and disturbed the reparative process so favourably set up, and perfecting its earlier stages. After the same manner the internal side of the splint was restored to its position, together with the front splint, and all retained, as before, by the straps and buckles. The patient quickly returned to consciousness, the inhalation of the chloroform being stopped.

15th. Slept well; complains of no pain; occasional doses of opium; wine and beef-tea freely.

20th. Since last report she is greatly improved both in appear-

ance and in strength, and she sleeps now without an opiate; appetite sharp for animal food; no sweats; pulse 86; bowels and kidneys acting regularly. The limb has not been disturbed at all, and it rests quite in a state of repose. The œdema of the leg has vanished, proving the correctness of the view already expressed as to its presence; there is no swelling nor redness; no cramps, no startings, and no undue force acting anywhere; the pressure from behind forwards is so gentle, so accurately regulated, that all secretion from the lateral wounds finds its way forwards, and is there sopped up with a piece of sponge as quickly as it appears.

22nd. Owing to the patient complaining of "scalding" at the sides of the wound, I was induced to remove the dressings; crowds of maggots were crawling about, giving occasion to the uneasiness referred to. The patient was placed under chloroform, and I removed all the dressings, holding up the limb myself, steadily and rigidly, with my right hand grasping the thigh, and the left the leg above the ankle, keeping the former gently backwards, and the latter rather forwards, with a compressed force pressing the cut surfaces together; and thus their adjustment was undisturbed; the box, prepared with fresh pillows, &c., was again slipped beneath, and all readjusted as before, with the greatest comfort to the little patient; when fully aroused from the effects of the chloroform, an opiate was administered.

23rd. Slept all night; no pain or annoyance of any kind; no sweats; no restlessness; pulse 80, soft; appetite good; healthy purulent discharge freely from the lateral wounds, anterior one healed.

25th. Let down side splints, and replaced folds of linen, and cut out all stitches; transverse wound entirely healed, and lateral ones looking quite healthy, with florid granulations, and pus not over-abundant; sleeps and eats well; union between the bones become quite steady.

February 6th. Going on most steadily in every respect, on the 18th, however, was compelled to open a very large abscess, extending up along the biceps muscle; it gradually improved up to April 20th, when suddenly, in opposition to the most careful dressing, the equable support of pads, &c., the abscess seemed to pass gradually upwards, even to the very trochanter, with distinct fluctuations in front of it; by the introduction of a probe, it was evident that this was one uninterrupted track from the external wound, and having confidence in Chassaignac's method of treatment, according to his directions I conducted a draining tube from one end to the other of the thigh, so as

to facilitate the escape of all secretions. I believe this to have been the first application of the means "drainage" in the management of those extensive abscesses so frequently noticed as occurring after excisions. After the introduction of the tube, the limb was very lightly rolled and steadied as before; but little constitutional excitement followed this novel mode of treatment; though apparently severe, yet, when cautiously and expeditiously done, but little shock is occasioned. On the 25th there was a striking improvement; the discharge being in a very remarkable way lessened, and what was secreted freely flowed off by the tubing: the gentle bandage support tended to this favourable sequence. Coexisting with this amended local change was a striking subsidence in the constitutional derangement: the appetite was better; the sleep was improved, it was quiet and undisturbed; the sweats had ceased, they were checked. During the several days, the consecutive weeks, which followed up to the 1st of June, steady, progressive amendment was prominently marked, so much so that I withdrew the drainage tube, there being scarcely a drop of fluid conducted by it, so contracted was the interior of the pyogenic cyst, and so completely consolidated were the parts around; on taking it away, a few drops of blood flowed, showing how closely applied to the foreign body were the healthy granulations which sprung up from the walls within, embracing it in the long track through which it traversed; but it well fulfilled its office, and the time had arrived for its removal. The limb was afterwards supported by the circular turns of a long roller, and steadied on a splint applied to its posterior surface, and retained as before; the apertures above and below were left uncovered; the bandage was not permitted to rest upon them, thereby allowing a free escape to any matter or oozing of blood that might take place. So improved did the patient appear in every way, that she was allowed to sit up in bed, being propped by pillows. At the end of the month not a drop of matter from the vicinity of the knee, or the lowest aperture, or lower two-thirds of the thigh, a few drops passed by the upper wound; so improved was the little creature, that she was carried each day into the garden, and allowed to sit or recline upon a couch, as her feelings suggested. By this "great recreation," as she termed it, the improvement in her general appearance was most striking and significant. So matters progressed until the early part of September, when another large abscess formed in the popliteal space, and was opened at this time; soon after, she was attacked with erysipelas of a most serious character, which was prevalent in the next ward, and suddenly seized upon my

patient, attacking the affected limb, passing up along the belly over the thorax, round the back, and down the sound limb; for several days the life of the creature was in most imminent peril; however, by careful management, the due exhibition of wine, bark infusion, and suitable local applications, the disease was stayed, the danger averted. Now so intensely painful was the limb, so great was the swelling, the tension, the heat, pricking and burning of the skin, that the support had to be taken away, the splint from behind, the encircling bandage to assist the enfeebled capillaries, the retentive bandages without,—all had to be taken off; and yet so efficiently had nature done her work, assisted by the science and art of surgery, that the connexion between the thigh and leg remained a permanent bond, a rigid union. No untoward result followed this very trying crisis, and even now (the 12th of October), though the storm has not yet entirely subsided, yet the limb remains as straight as before its coming on, and she even now possesses the power of lifting it *en masse* from the bed, or rotating it in its acetabular socket. Shortly after, even the small discharge ceased, and now only two or three drops can be pressed out. The result which I have detailed here, though I think not noticed by writers, I have before observed in cases of extensive abscess, deep-seated in a limb: when erysipelas of a serious nature has attacked the part, it finally terminates in altering the action of the secreting surface, evidently from its powerful derivative effects, and establishes the basis of a change, *permanent* in itself, that quickly goes on to repair and cure, altogether different from the *temporary* drying up of surface sores when erysipelas seizes on them.

During the last fortnight she had been walking about the wards, with the aid of crutches at first, but now only a light stick is used, more as a preventive against slipping or injury, than as an essential for support. The limb is beautifully straight and well formed, stiff and rigid at the knee; no pain at any part when resting the weight of the trunk fully upon it; and it is very remarkable how yielding and obedient the muscles about the hip have become, and how greatly restored the flexion and extension of the ankle-joint—indeed, I think the rapid restoration of its motions is in a great degree due to the position of the foot being steadily maintained throughout the entire treatment at a right angle with the leg. I have before dwelt upon the value of this practical lesson, when writing upon fractures in the vicinity of the ankle-joint^a. Coincident

^a Dublin Quarterly Journal, 1852.





Forster & Co. lith Dublin

with this great local change is the constitutional improvement: the miserable, the pitiable condition already described as marking her state on admission to hospital, has altogether disappeared. As the source of irritation was removed, so the withering results of fever, the striking emaciation, were replaced by a healthier action, a more perfect assimilation, an increase of bulk of the entire body; and now the little girl has a bright colour, a fresh and cheerful expression, a tranquil look; health. Numerous complications and dangers assailed this creature's life, but by careful management she has been steered through all; and the result to me is most cheering, and a great recompense for all my trouble.

According to my usual custom, the portions of bone removed, the casts before and after the operation, are placed in my private collection; and the engraving, Plate II., gives a most faithful picture of the little girl as she stands, this 10th day of December, 1858.

CASE II.—*Another successful Excision of the Elbow-Joint, in which an unusually large amount of bone was removed; Recovery with the most perfect use of the Arm and Hand; Mechanical appliance for putting up the limb.*

Bridget Kilkenny, aged twenty-five years, admitted to Mereer's Hospital January 2, 1858, under my care, by a special recommendation from the country. She laboured under long-continued disease in the elbow-joint. It commenced in November, 1855, without any assignable cause; great pain suddenly set in, accompanied by considerable swelling. By a simple, yet efficacious mode, leeching, poulticing, aperient medicines, &c., persisted in for some time, the urgent symptoms were relieved, that is, their intensity, for the pain never entirely forsook the part; and she suffered and worked, and at some times even when enduring great torture. By degrees the bulk of the joint became greater; its size augmented; its discoloration more developed, and finally, after a slow process of thinning of the parts, they gave way, six weeks before her admission, discharging a copious amount of purulent matter; from this time to her being submitted to my care the secretion continued to be poured out just as abundantly. On the date above registered, her sufferings were very great, and she truly appeared a wretched spectacle: she was haggard, sunken, worn out from persistent pain, from sleepless nights, wearying restlessness, constant spasms and startings in the diseased limb. Her appetite was gone, all relish for food lost; vomiting and emaciation followed, and was rendered more conspicuous from

contrast with the large bony frame of the patient. The limb was inordinately swollen at the affected joint; it measured three times the circumference of the sound limb, and this enlargement stood out in greater relief, owing to the wasted state of the arm, while the forearm was œdematous. A large ulcerated patch was situated on the outer and back wall of the articulation, which discharged synovia and pus abundantly. On introducing a probe by this aperture, it passed freely into the joint, and in traversing this course the olecranon was discovered, exposed, carious, and the interior of the joint rough, uneven, spiculated, and the extremity of the shaft of the humerus reduced to a similar state, thickened and enlarged far beyond. The slightest motion of the joint gave the most excruciating torture; this was guarded against by the patient with the sound limb firmly grasping the enfeebled forearm, and rigidly maintaining it close to the side; her thin, sweaty, œdematously flabby hand remaining in the state of extension. From a careful consideration of these local changes, the wide-spread ravages of disease, the opinion was arrived at that no salutary crisis could be anticipated; that no healthful or reparative change could be brought about; that the interference of the surgeon was absolutely demanded to take away the offending part; to quiet down, to check the constitutional disturbance that threatened life. Though conceded the propriety of adopting operative measures, yet in what that extension of resources consisted, remained a question for deep and anxious consideration; it was one momentous to the sufferer; it was one hazardous to the reputation of the surgeon. Many would have supposed, from a superficial consideration of the case, that amputation of the limb afforded the only resource; and indeed the wide-spread destruction, the extensive implication of the parts within and without the joint, might have given some foundation for so erroneous a view for such an arbitrary measure. However, after a long and pains-taking examination of the part, —of the bones within and the structures without, repeated and investigated with the greatest delicacy and gentleness over and over again,—I was led to the inference, that excision of the diseased parts might with propriety be adopted. An early inquisitiveness in the complications of such cases, reduced and rendered practical by later investigation and deeper inquiry, prepared me to act with decision and promptitude, according to the deductions which I made, the prognosis that I arrived at. The numerous papers on excisions of the knee, the elbow, the wrist, and minor articulations, published in this Journal, most forcibly urged, most strenuously inculcated the propriety

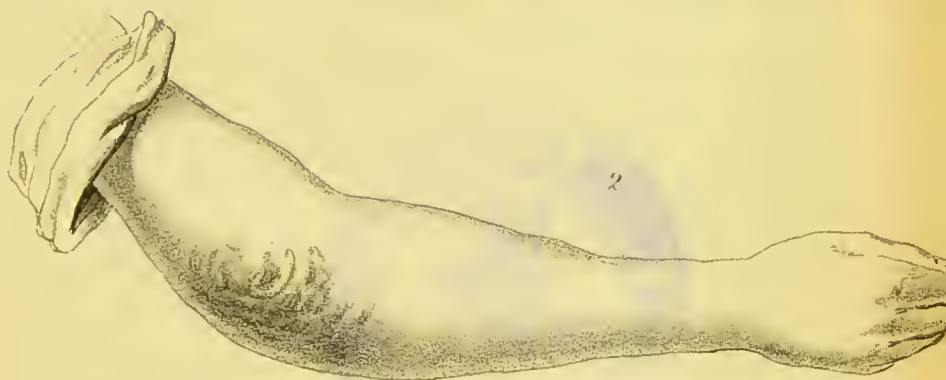
of sedulously avoiding display, and applying alone the operation suited to each case, so that surgery should not be defeated, or the science of the art thrust back by the rashness of her votaries, or the ignorance of her followers.

Some time before the patient left the country, she had been placed under the influence of mercury, gently and steadily administered, but with no good result. On her coming to town, indeed, the effects of it had not entirely passed away; besides, there were other obstacles to immediate operation: the fatigue consequent upon a long journey; and the natural monthly change was expected in a few days. So it was not until the 18th of the month that I was enabled to put in practice the operative measures suggestive of preserving a serviceable limb. On this date, then, I excised the joint after the following mode:—

The patient being placed in the horizontal posture on the operating table, she was quickly brought under the influence of chloroform, and then gently rolled over on the left side, so as to enable me to act upon the right elbow-joint with the greatest facility and ease. An assistant steadied the arm, and had the brachial artery, if necessary, under control, while a second steadied the forearm. In this instance I adopted the H incision, making the internal line first, and that in the course of the inner edge of the olecranon, so that the ulnar nerve was lifted from its bed undisturbed from the soft parts covering it. The cross incision was next made, and that above the olecranon, freely detaching the triceps from that process; room was not afforded by this amount of incision for proceeding, and the H-shaped wound had to be completed by the external longitudinal cut. The flaps being dissected back, the lateral ligaments were divided, and forcible flexion of the forearm made, so as to thrust the bones backwards; the amount of disease revealed was very large. The incrustating cartilage of the extremity of the humerus was entirely removed, and the supporting osseous prominences nearly levelled; caries had eaten away even the outer layers of the bone at its expansion above the condyles, and the soft parts had to be freed from the shaft above this point, and the bone cut from before backwards. In the same way the entire olecranon was diseased, as also the shaft of the ulna where it expands into that process; not only was the articulating extremity thus denuded and carious, but the cartilage of incrustation lining the greater sigmoid cavity was altogether gone, and the bone in many parts deeply removed. The head of the radius was involved in the mischief, its cartilage was in process of ulceration. These several parts

being carefully freed from the attached muscles, the fine blade of the saw, invented by myself for such purposes, was placed in front of the bones, and their section effected from before backwards; thus, the head of the radius was taken away, and the olecranon and a portion of the shaft of the ulna. The extent of the humerus removed measured three inches and a quarter, and that of the ulna, just an inch and three-quarters, together with that amount of the radius corresponding to the section.

On a very careful examination of the osseous sections, healthy structure was in each visible. So carefully was the knife kept to the bones in their detachment, that no vessel of sufficient magnitude to require a ligature was divided; the flaps between which lay the transverse incision were then brought into contact, and retained by four points of interrupted suture; the lateral incisions were left open, and a few strips of dry lint laid superficially in them; the entire limb was then supported in the box which I have used in similar cases. A few words as to its construction, and the "putting of the limb up." The bottom of the box is made in one piece, the part for the support of the forearm being placed at somewhat less than a right angle with that for the arm; the side-pieces are divided at the angle, so that there are four, which let down by hinges, and thereby easily permit the dressing of the wound. The pads being adjusted, the arm was evenly supported throughout, and the forearm and hand rested on its ulnar edge, and steadied in a similar way; the sides were next elevated, and all spaces filled with suitable pads, so that an equable pressure was maintained from the shoulder to the extremity of the fingers. As in the apparatus which I prefer and have figured for controlling the limb after excision of the knee, there is a splint placed in front of the thigh, to control the starting forward of the bone; so, likewise in this apparatus for the upper extremity, there is a splint which must be applied from the acromion above along the outer surface of the arm, and as low as the angle to guard against the starting of the bone outwards, a deformity which it is most prone to assume. This splint, properly padded and laid on, is retained by the web-bands which girth and support the sides of the box, and are buckled on the outside. The annexed engraving shows the adjustment (Plate III.) The dressing of the limb did not take up any length of time, the patient being all the while under the influence of chloroform; thus insensible, she was carried to bed and arranged comfortably in it before consciousness was restored; afterwards she recovered quickly from its somnolent effects, but was teased by vomiting and prostration, consequences





which I have frequently seen to arise in some habits. By the free administration of warm wine and opium, this condition was removed; and by 4 o'clock the stomach was quiet, the shock had passed away, the circulation was well established, and the limb lying comparatively easy. Opium and stimulants were ordered to be given freely through the night. On the following morning the prostration was again induced by nausea and vomiting. Prussic acid and morphia after a few doses quieted the stomach; and brandy was administered; at 3 o'clock P. M. a cup of beef-tea was taken with desire.

January 20th. Had a good night, and quiet in every respect. Pulse steady and good: limb in excellent position, and free from pain. Stimulants, opiates, and nutriment freely allowed.

23rd. Readjusted the pads, splint, &c., taking good care to steady the limb, and keep the forearm well pressed up to the arm. The cut ends of the bones are as nearly together as consistent with the rectangular position which they were forced to maintain, thereby rendering as short as possible the fibro-ligamentous union sought for.

25th. Enjoys uninterrupted sleep. Able to partake freely of food, &c. Wounds look quite healthy, and suppuration freely established. Removed the sutures; transverse incisions united throughout.

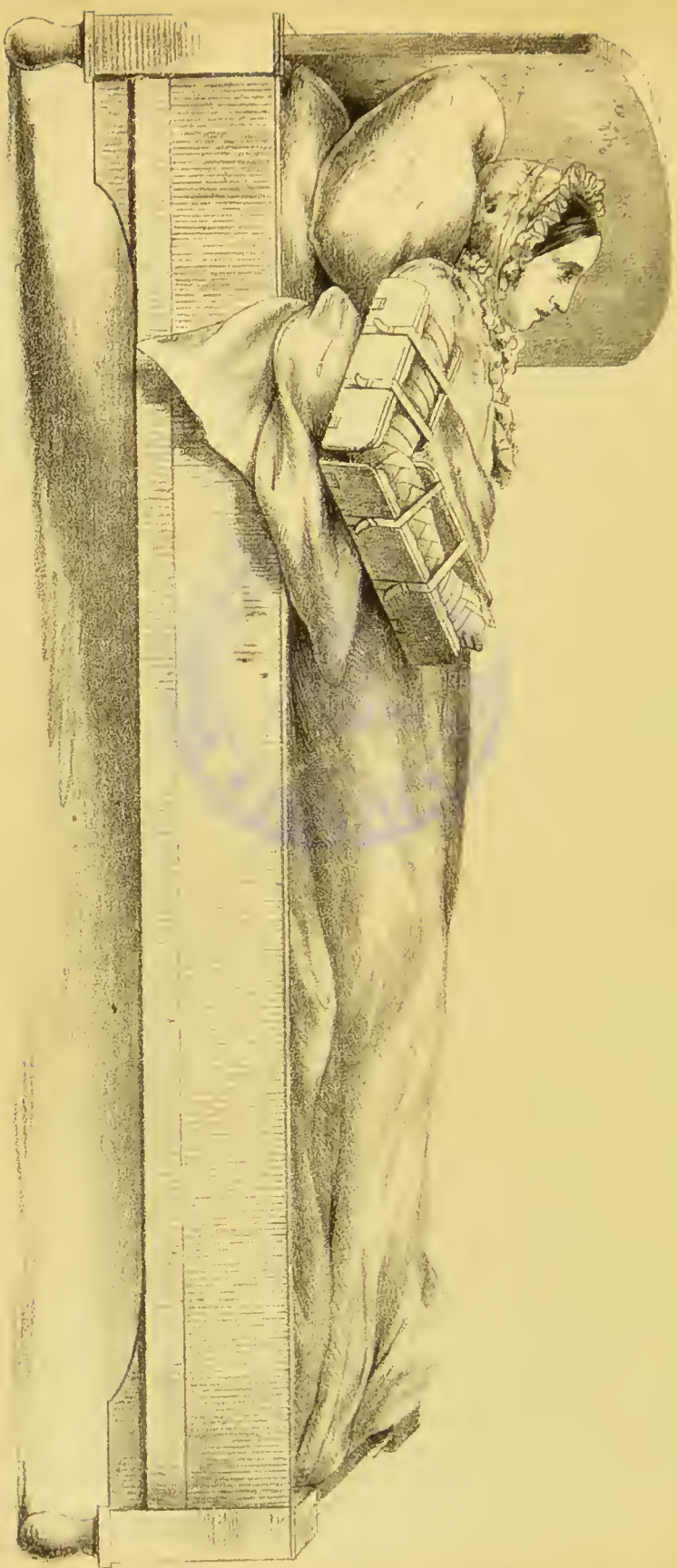
From this date until the 6th of February, nothing remarkable occurred. The limb was dressed after a similar mode to that detailed. Gradually the wounds granulated; the discharge diminished, so that at this date there was very little indeed; and so effectually were the parts applied to each surface of the limb, and so steadily was the forearm kept pressed up to its berth, that there was not the least pouching of matter, all that was secreted being drawn out, and by the simple arrangement of the box, was readily sopped up, and prevented from rendering the dressings foul. Coexisting with this beneficial aspect of the limb was the salutary amendment marked upon the general health; all delicacy of aspect had nearly disappeared.

February 20th. The external incision discharged only a very small quantity, the internal being healed, and the transverse, as already mentioned; the structure interposed, thrown out, organized at the site of resection, was firm and condensed, and promised well as a uniting medium. At this date I was enabled to lay aside the box, and use as a substitute a light gutta-percha trough, shaped like the box, in an angular form, and which nearly embraced the posterior and inner surfaces of the limb, and extended from the shoulder and axilla above to

the middle of the hand, thus leaving the fingers free ; by this appliance the limb was effectually steadied ; by its not surrounding the limb, unpleasant heat was avoided, and the only part requiring to be dressed lay outside. Owing to the lightness of the material, at the same time possessing sufficient rigidity, a very moderate application of an ordinary roller maintained it in position. The entire was then supported in a sling suspended from the woman's neck. After this arrangement the patient was allowed to sit up in bed, supported and propped up by pillows. In a few days after, she was permitted to get up and walk about the ward, and to go into the garden during the sunny part of the day. Thus the case progressed most favourably, the constitutional improvement keeping pace with the local amendment. Gentle flexion and extension of the wrist and fingers were daily made ; and soon the power of grasping was remarkably restored, the external wound being healed altogether on the 20th of March. From this date up to the period of her leaving the hospital in the first week in June, the advancement towards perfection in the restoration and use of the limb was most satisfactory. A great lesson was taught here, because a very great portion of the humerus was taken away, and, indeed, of the diseased forearm ; yet by careful management, proper adjustment, such a connecting medium was secured, as to render the member, though shortened in its proportions, as well qualified, after some time, to meet the exigencies of its requirements, as when possessing its most perfect symmetry.

I had every reason to anticipate and look forward to so happy a consummation. For weeks back the forearm has been retained in a sling, without any control or mechanical appliance whatever. Day after day a constant gentle exercise was put in practice ; the power of flexing and extending the fingers was regained ; the similar motions of the wrist were restored ; and the united combination of these forces maintained the grasp as powerful and secure as that of the sound limb. While the acts of pronation and supination were restored to their entirety, the only motion delayed, defective, was that of flexion of the forearm on the arm when the limb was allowed to fall into the extended state. Though short, condensed, and firm, this newly formed structure between the bones was such as was most desirable to be procured, yet, to the uninitiated or ignorant in such matters, it had the appearance of defectiveness, because not as yet sufficiently rigid to steady the wavering actions of the muscles around, uneducated in their new attachments and shortened state. From the rapidly improving state





of the limb, the perfect restoration of the power of flexion might with certainty be looked for; for even at this early period of the cure, if the forearm was only raised in the slightest degree, bringing it to a very obtuse angle, the wavering limb was brought up the remaining way by the flexors, it falling suddenly against the humerus, because the extensor muscle behind had not as yet recovered its antagonistic office. The patient had the power of traction with the limb entirely restored; and to look at it, it was stout and as well nourished as the sound one. I have given a faithful picture of the arm before and after operation (Plate IV., Figs. 1 and 2, beautifully engraved by Forster). She went back to the country perfectly restored to health, large, fat, and buxom. I have beside me at this moment (writing October 26th) a letter from my friend Dr. Poyntz, of Athlone, confirming even a greater improvement in the issue of this case, about which he was naturally most anxious, he having submitted her to my care. He writes:—"I would have answered your letter sooner, but was waiting until I should have a personal visit from Bridget Kilkenny. She was away in the country, making shirts, for the last ten days. The arm is quite well, and she performs every motion perfectly, with the exception of being entirely able to raise it upwards. Her health, in every respect, is excellent." Nothing, surely, can be more gratifying than the result of this case. It teaches a very grave lesson. At the first, from the beginning, there seemed to be a doubt cast upon the propriety, at least on the expediency, of excision, owing to the implication of parts being rather extensive—more so than what usually takes place when those conservative operative measures are had recourse to. But while dwelling upon the success of this case, while weighing every particular, I would urge upon the investigator this great practical lesson: the necessity of making himself acquainted with the amount of disease in the bones, the extent to which it has progressed, prior to having to do with any such undertaking.

In the foregoing report we have the conviction forced upon us, be we willing or not to receive it, that in this very unpromising case we have all the motions of the forearm, and the complicated and delicate movements of the fingers, rescued absolutely from their paralyzed state, and restored to their minutest functions. The only action of the limb not normally regained is that of flexion of the forearm on the arm; but I believe this, too, to be only delayed, not finally denied. Practically speaking, the following case illustrates well the point: A few years ago I resected the elbow-joint of a man far ad-

vanced in years. The portions of bone taken away were considerable; and after due time the wounds healed, the parts were consolidated, and all the motions of the forearm and hand restored, save the power of flexing the forearm on the arm when the limb was extended. The patient shortly after left the hospital, and I lost sight of him altogether. However, in the early part of last winter, when quickly walking through the street, I was saluted by a person passing by. Having taken no particular notice of him, he ran after and accosted me, when I recognised, after a few moments' scrutiny, this very fellow, about whom I had made many inquiries. Being delighted at seeing him able to use the arm so efficiently in taking off his hat, I requested that he would call at the hospital on the following morning, to which he readily assented. I presented him to the class, with his hat on, and made him take it off and put it on alternately with each hand; and having made him perform several offices, not one could detect any defective motion. I next stripped him, and exposed, greatly to their surprise, the arm which had been operated upon. It was well nourished, and its muscles as well developed nearly as the sound limb. In addition to all these minor motions being restored, the power and vigour of the limb were regained. This he quickly put to the test, of his own accord. Seeing a large bucket of water, holding, at least, four gallons, in the surgery, he lifted it by the handle, and walked up and down with it. He next, with the same arm, lifted the bucket from the ground, and placed it upon a table fully three feet high. This he did several times, with steady power, flexing and extending the forearm. The act here recounted called for great muscular exertion, and affords in itself a conclusive evidence as to what may be anticipated and looked forward to in similar instances. A great practical fact is inculcated—a great practical lesson is taught. How true, then, the hopes which I foreshadowed, when writing upon excision of joints in an earlier Number of this Journal:—"The surgeon need not be disheartened by the tediousness of recovery; in the end it will come." And as a greater confidence to his efforts, let me again quote the impressive and simple words of Moreau:—"If these things seem to be incredible, they may be easily brought to the test of experiment. I am firmly of opinion, that in similar circumstances the issue will be the same"^a.

In some instances, and indeed in the practice of every hospi-

^a Butcher on Excision of Joints, Dublin Quarterly Journal, 1855.

tal surgeon, cases will present themselves when it will not be either advisable or necessary to subject the patient to so serious an operation as cutting out the entire articulation, when, for instance, only a portion of the articular surface of the humerus is carious and diseased, together with its corresponding condyle, a partial resection will be sufficient. I shall presently illustrate what I wish to enforce, by an admirable example of the practice. Before doing so, however, I would wish to say one word about the management of those cases of diseased joints in infancy and childhood. It is impressed strongly upon my mind—nay more, I would say it is my conviction, from a long and careful study of such affections—that those severer operative measures will very seldom indeed be either warranted or called for. This rule applies even with greater force to the upper extremity. I could cite numerous instances, most unpromising at first sight, where, by judicious surgical interference, the limb has been rescued. Childhood does not seem to be the recipient of the same wasting, destructive fever that takes possession of the constitution in the adult; and during the periods of early life repair is quickly brought about, owing to the extreme vitality of the living tissues. The part destroyed is, with amazing rapidity, regenerated and restored. How often do we see this fact forced upon our observation: a child is brought into hospital, having been thrown down in the street by a car rapidly passing by; the wheel has lifted a large flap from the skull; the violence which has torn and lacerated the soft parts has denuded the bone, probably chafed away its superficial surface; and yet, though this injury would surely kill the osseous tissue in the adult, in a few days we see the injured part, pink, reddish, covered with granulations sprouting up from every point, and incorporating themselves with the flaps, equally prepared by the hasty removal of all gritty matter and contused tissues. So is repair in the young to be looked forward to, to be depended upon as a certainty; and therefore again I repeat—no hasty removal of diseased joints in childhood.

I shall now recur to the case illustrative of partial resection of the elbow-joint, when the disease is limited in a certain way.

CASE III.—*Partial Resection of the Elbow-Joint, where the disease is limited in a certain way; Recovery, with a most useful limb.*

At this very moment the person whose case I am about to describe is a patient in the hospital, suffering from fracture of

the fibula, an injury which he sustained a few days since ; so that both myself and the class of students attending the hospital have the advantage of closely examining the arm, observing its powers and its motions, and interrogating the man in every particular. His case I extract briefly from my note-book:—

Robert Sheridan, aged 24 years, admitted to Mereer's Hospital April 20, 1854. *History.*—For many years back he has had his right arm and forearm anchylosed at a right angle, the result of disease attacking the part in early life. During latter years he has met with many injuries of it, occasioning, at times, great inflammation; but in all instances relieved by treatment, confinement to bed, &c. However, six weeks before his admission, as above dated, he got a severe fall, and was pitched upon the maimed arm with great violence; very high inflammatory action ensued; abscesses formed and burst anteriorly, corresponding to about the centre of the articulation, or rather a little to its inner side, and somewhat above the angle of flexure; pus, serum, and blood were discharged freely for several days, and after about three weeks the latter entirely disappeared, while the former continued in smaller quantity, with an abundant admixture of synovia. Thus the case passed from bad to worse; the neighbouring parts were tense and swollen, and the wrist and hand stiffened by œdematous engorgement. A secondary abscess had recently formed, too, behind the internal condyle, and the integument and fascia were bridged across the sinus that formed the communication between it and the original or primary abscess in front. By passing a probe through the aperture in front directly backwards, and then a little downwards, it came upon exposed bone, and from the freedom with which the soft parts were detached, the amount of diseased bone could be readily traced out, and was, with almost accurate certainty, entirely defined. There was no hesitation in pronouncing the extremity of the inner half of the articulating surface of the humerus, the internal condyle of the bone, and that portion of the expansion of its shaft immediately above the two, and connecting them together, in a carious state. They were rough, gritty, and softened, and yielded to the pressure of the instrument, which, by a little force, could be made to disintegrate and break up their texture.

Such was the local condition of the parts when the man was admitted to hospital; and the attendant constitutional prostration, with great emaciation, required immediate interference. I operated on the part in the following way:—The man was placed sitting in a chair; the arm was drawn from the side, and held rigidly elevated at more than a right angle with the trunk. It being so fixed, I made an incision fully three inches and a

half in length, commencing below the internal condyle, over its most prominent part, and up along the ridge leading from it to the shaft. All along this course the knife went down to the bone, and in its upper part, of course, lay behind the brachial artery. The extent of the incision permitted the diseased bone to be sufficiently exposed, great caution being taken to lift carefully the ulnar nerve from its bed behind the condyle. Wide copper retractors facilitated, in a very remarkable way, these proceedings, at the same time affording a protective security to the very important part enroached upon. A few scattered shreds of the internal lateral ligament remained, and the extent of disease in the bone was clearly revealed by the steps taken; then, with a powerful, long-armed, bone forceps, I clipped away the internal condyle, together with that part of the humerus originally forming the trochlea for articulation with the ulna, as far outwards as the ridge of bone separating the radius from the ulna; and finally that expansion of the bone above and connecting these two processes. All cartilaginous structure was entirely removed from the trochlea, and the bone eaten deeply above it. The cutting away of these parts seemed to include every thing obnoxious. Great caution was observed to keep outside the limits of disease, and certainly the section presented a healthy aspect throughout. Two arteries required to be ligatured, and then the flaps were laid down and gently brought together. They lay so by the support of a few straps of plaster. The limb, as already mentioned, was permanently ankylosed, the product of former inflammatory attacks, at a most suitable angle, and in this attitude it was supported upon a splint, cut out according to the same shape. Pledgets of lint, steeped in cold water, were laid over the wound, and a few turns of a bandage steadied the entire. The patient was afterwards placed in bed, the limb slightly elevated, and supported upon pillows.

It is unnecessary to follow on the history from day to day; it is sufficient to say, that no untoward event, no disagreeable casualty, occurred; that after about six weeks he was discharged from the hospital with the wound perfectly healed up, and an entire absence of pain in the part. As I before said, we are afforded now, at the expiration of four years, an admirable opportunity of examining the part in all its bearings; and its appearance is most accurately represented in Plate IV., Fig. 3. Never, from the time that the patient left the hospital to the present, did he suffer the slightest inconvenience in it; no recurrent abscesses, no sinuses, no neuralgic affection, or loss of power. During several years he has been employed in active

occupation in driving horses and tending cattle—in the daily engagements of a labourer—yet in all these varied and several requirements the arm never failed in its offices, nor compelled him to relinquish any. At this moment it is very perfect in its proportions; it is quite efficient for all its actions, save and except that of extension; yet the patient perfectly compensates for this denial by gracefully bending or yielding with the shoulder in what may be called the performance of all the under motions of the limb. Its bulk is but little reduced; and the power of traction with it is just as great and secure as that enjoyed by the sound limb.

I have dwelt thus at some length on the merits of this mode of partial resection, as demonstrated in its applicability to the elbow-joint; but the line of argument enforced, the benefits to be derived, the hopes to be fulfilled, cannot by any means be transferred in its adaptativeness to the knee-joint. The simplest consideration of the offices, the requirements of each articulation, will at once afford a solution to the question. In writing upon excision of the knee-joint, I forcibly dwelt upon the impropriety of partial excision, and for more minute particulars must refer the reader to the papers published in this Journal. The force of the conclusion to be arrived at is, if possible, more pointedly urged if the resection should take the line of the axis of the limb. I have already shown that for the perfect services of the lower extremity after excision of the knee-joint, it is essential that too much bone should not be taken away, if so, two evils militate against the capabilities of the limb: first, the undue shortening of the member; and secondly, from the opposed surfaces being so limited, a sufficient mutual resistance is not afforded, essential to the perfection of union and solidity. The same reasoning is just as applicable to vertical excision: if any portion of the femur or of the tibia entering into the articulation should be taken away, the area of resistance becomes too diminutive for the sustentation of the body; thus the limb would be weak in its stability, tottering and unsteady, defective as a means of progression.

Amputation at the Ankle-Joint; Syme's and Pirogoff's Operations.

In the Dublin Quarterly Journal for August, 1851, will be found a short paper of mine under the head of "Cases of Amputation; invention of a new saw." In this communication I made certain observations upon amputation at the ankle-joint, which were drawn from me by the particulars of a case in which I had to amputate the leg, subsequent to Syme's

operation at the tibio-tarsal articulation. It is pleasing to look back upon opinions delivered years gone by, and to learn, by a deep and sedulous inquisitiveness into them, that they were not at least hasty, premature, or arrived at without sedate deliberation; and here, with much humility, I would submit that it is too much the fashion of the day to describe bold and daring operations performed by dexterous hands, without that searching inquisitor, result, even being introduced, or made mention of.

In the case to which I have alluded, after dealing with it in the fullest way, making mention of the pathological changes, describing the anatomical arrangements of the adjusted and fused parts, &c., I expressed my conviction thus:—"From my own observation, and the facts now detailed, I do not consider this operation at all so applicable to the poor labouring man as to the wealthy sufferer; the latter may at will relieve the stump from pressure by expensive mechanical contrivance, horse and carriage exercise, &c. &c.; while the former, no matter what amount of uneasiness he may experience in the part, must endure and struggle on for subsistence, and probably in the end have to submit to another operation."

At this time, too, I quoted, in opposition to this, a passage from a Lecture delivered by Professor Fergusson on "Amputation of the Foot at the Ankle-Joint," and printed in the *Medical Times* for June of the same year; it runs thus:—"Whilst making these observations on the superiority of this operation, it would not be right in me to lead you to suppose that it is invariably successful, or that it is not sometimes attended by fatal results. Of the eight patients I have operated upon, two died after it; in one, death followed directly from the proceeding in a few days, as it would ensue after any other amputation; great irritation and inflammation ensued, and quickly carried the patient off. In the second case it would not be fair to put the issue to the operation itself, as the fatal termination did not happen until several weeks after, and it was due to disease of the lungs, which had rapidly supervened after the foot had been removed."

I remarked at the time:—"This mortality, then twenty-five per cent., I look upon as very considerable, more particularly when occurring in the hands of this distinguished surgeon. It is greatly to be regretted that Professor Fergusson did not allude in his Lecture to the present condition of the remaining six of his cases, whether the stump in each case fulfils efficiently the object for which it was intended, and whether any of the patients solicited amputation in preference to being in-

cumbered with a useless limb." I had seen at the time three cases, all of which were unsatisfactory, unsuccessful. Months passed by, and the revelation from the periodicals of the day was so strong in its favour, that, after reconsidering the entire matter, I determined, when a suitable case offered, to put the operation practically to the test for myself. The following is an instance of its application:—

CASE IV.—*Syme's Operation at the Ankle-Joint; Recovery.*

Mary Egan, aged 45, admitted to Mercer's Hospital, March 1, 1853. *History.*—She states that, six months before admission, swelling attacked the metatarso-phalangeal articulations of the three outer toes of the left foot. The swelling became considerable, and in a short time the entire instep partook of the same uneasiness and pain; abscesses formed on the outer side of the foot, and matter was freely discharged from several incisions. On coming into hospital, the following was the state of the parts, as taken from my note-book:—"The arch of the foot is filled up; all the bones are expanded, particularly the os calcis, and the tibio-astragalean articulation seems free from disease, and admitting of motion without uneasiness or pain, while the slightest degree of motion communicated to the bones of the tarsus caused the most excruciating suffering. The power of progression, or laying the weight of the body on the foot was entirely lost; and four months before her admission, the hamstring tendons were slightly contracted, from the constrained position adopted to save the part from touching the ground as she hopped along on crutches. The general debility and emaciation were very great. Pulse 125.

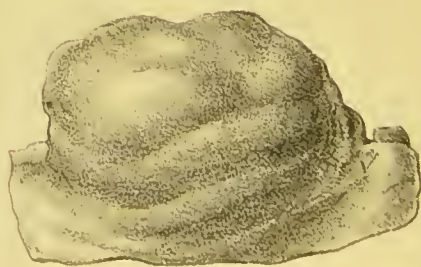
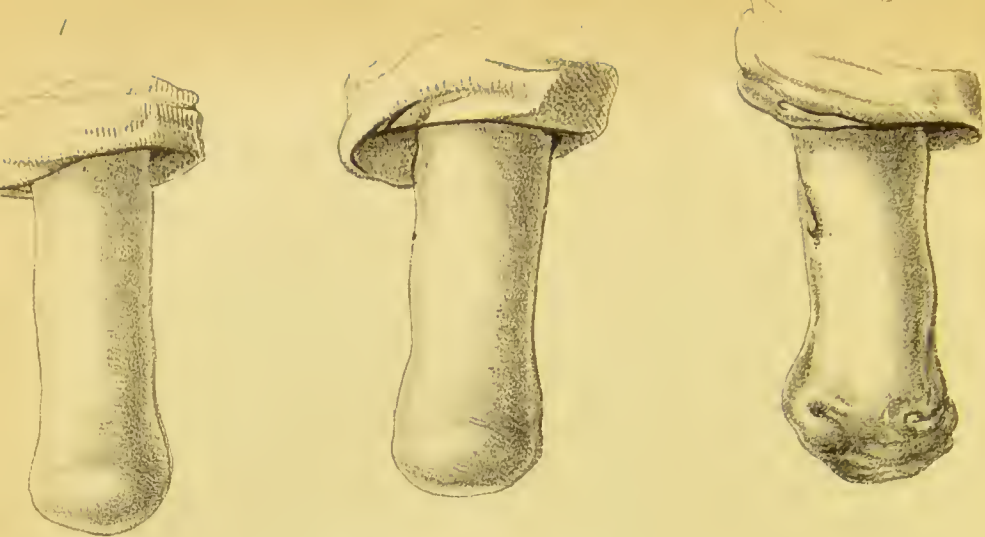
I considered this case most suitable, in every way, for amputation at the ankle-joint, and was determined to test its capabilities when all promised so favourably. On the 7th I operated in the following way: the patient was placed under the influence of chloroform, and the ankle grasped by an assistant, to command the arteries; the first incision commenced just below the tip of the inner malleolus, and was carried with a slight curve, convexity downwards, across the ankle-joint, to the tip of the outer malleolus; I then passed the same small amputating knife beneath the foot, placing its edge at the inner side of the commencement of the first incision, and carrying it slightly curved, convex downwards, across the sole of the foot to a similar point on the outside, meeting the terminating angle of the first incision; this cut was made through the entire depth of the parts in the sole of the foot. I next put aside the large knife, and with a scalpel dissected up the flap from the

forepart of the joint, and plunged the knife in and cut down the internal lateral ligament, close to its attachment; and the inner edge of the flap from the sole, and then executed a similar proceeding on the outside: all this time being most cautious to keep the knife as close to the bone as possible, more particularly when acting on the internal side, so as to avoid the posterior tibial artery, and not cut it before its division into internal and external plantars. I next forced the foot downwards, holding it firmly with the left hand, and, with the knife steadily kept to the astragalus, continued the dissection backwards, cutting across the attachment of the tendo Achillis, and cautiously freeing the granular soft parts from the bone until it was denuded, and the heel flap left free; the integuments in front of the tibia and fibula were then dissected up nearly a quarter of an inch, likewise off the malleoli, and so all around, so as to permit the fine blade of my own saw to be placed behind the extremities of the bones, to cut off the malleoli together with the intervening cartilage and a thin layer of bone, from behind forwards: this being accomplished, the anterior tibial, the external and internal plantar arteries, and two smaller branches in the outer and under part of the flap, were ligatured. All bleeding having ceased, I at once brought up the flap, which fitted beautifully, and retained it by four points of interrupted suture; a compress was placed over the cushions and some long straps of plaster to support it steadily upwards; the patient was then conveyed to bed, and the stump raised upon pillows; a full opiate was soon after given in some warm wine; the posterior flap was cut intentionally small, so that it lay up to the bones, and no bag or pouch was permitted.

2 o'clock P. M. The patient suffering intense pain in the stump and up the limb; removed the bandage, leaving the flap supported by the adhesive straps, and placed a large compress of lint soaked in tincture of aconite across the ankle above the cut surfaces, and covered it with oiled silk; this application acted almost instantaneously in affording relief; repeated the full opiate; the stump was allowed to rest upon a hollow cushion, so as to remove all pressure from the posterior flap, and not interfere with its circulation. On the 10th of March the report is most favourable: slept all the latter part of the night, and is this morning free from all pain, and says she feels more comfortable than for the last five months. Stump does not require to be interfered with. On the 2nd of April all the ligatures were cast off, and on the 13th the entire is reported to be healed; however, on the 21st a small abscess formed about the centre of the cicatrix, accompanied by great pain. I

punctured with a bistoury, and let out a few drops of pus; the pain continuing after, I applied two leeches a little higher up, and enveloped the entire in a large warm stupe-cloth, and gave a full opiate; some relief followed towards evening. On the 23rd the pain was very great, shooting from a point very deep beneath the abscess, and extending along the nerve upwards. The whole back of the little abscess was highly sensitive, and from this the pain radiated. I cauterized the interior freely with a probe coated with nitrate of silver. On the following day the deep burning pain was subdued, but in a few days after I had to open another abscess, deep-seated, on the outer side of the stump; pus and blood flowed very freely, and much relief followed.

On the 20th all was healed, and the patient left the hospital for the country; and by repeated efforts at extension with the application of a splint behind the popliteal region, the contracted state of the hamstrings was overcome, and flexion and extension of the joint regained. On the 5th of August the patient returned again to the hospital; the stump was nearly solid throughout, only one point in front still discharging from a recent abscess, which gave way of its own accord. Having ineffectually tried various means to allay the uneasiness, to heal the part, on the 12th I made a free incision through the whole thickness of the stump, the sinus marking the centre of it; having in this cut laid bare a thick fibrous structure, I cautiously dissected it out, and it proved to be certainly an expansion of, or a new formation incorporated with, the fibrillæ of the anterior tibial nerve; quickly after, the wound healed, nearly by the first intention. In a few days later, pain seized upon the inner side of the stump, of a very severe character, yet all the wounds were healed. The tincture of aconite was applied as before, and with relief. On the 11th of September the patient was again dismissed from the hospital. Nothing could look better than the stump: it was round, elastic, beneath a firm, perfect cushion. In this state she went home, her friends and herself well satisfied at the part being healed. She was not away long when severe pain suddenly seized the stump, and terminated before morning in bringing on a fit of madness to which she was liable, and with which she was affected on two former occasions. In this state of total mental aberration, she was brought in again to the hospital, and, even when in this violent state, referred pain to the stump. The inhalation of chloroform and large pledgets of lint soaked in tincture of aconite, and laid along the forepart of the leg and round the ankle, subdued it. On the 1st of October the patient was again



restored to reason, the stump being entirely healed, and she so returned again to her own home.

Of course, on consideration of this case, we can in no way connect the mental aberration with the special operation performed; and upon strict inquiry, with great difficulties and obstacles placed in the way, I at length was credibly informed that this patient had been insane, and had threatened to take the lives of two of her children, eleven months before her admission for operation, and, consequently, before the tarsal bones were diseased at all. This imbecile condition has still existed; and, though the stump is perfectly formed, yet the patient never could be induced to use the limb in progression, though a suitable little boot was made for it. It is now five years and a half since the operation, and a few days since I visited the patient, and found her quite imbecile, sitting upon her bed, moving backwards and forwards, occasionally muttering some nonsense, but at intervals rational, at least so as to comprehend certain questions put to her, and her attention arrested suddenly when any questions were applied about herself, more particularly in reference to the condition of her leg.

In the case just cited there are difficulties which cannot be satisfactorily answered: for instance, nothing can be more perfect than the formation of the stump; it is a beautiful cone, somewhat flattened at its apex; it bears percussion, and strong, steady pressure with the hand, without the patient wincing—a beautiful picture of it is represented in Plate V., Fig. 1, taken by Forster from a cast in my possession—yet I could not get her to rest for a moment the weight of the body upon it. I was informed that she made several attempts before her madness assumed its present fixed form, but invariably complained of pain shooting upwards, of a very severe character, which made her desist from any further trials except when coaxed to do so.

In the following case I likewise performed Syme's amputation at the tibio-tarsal articulation; when, with the intention of executing Pirogoff's operation, I was compelled to adopt it, owing to the disease of the tarsus being more extensive than I could by possibility determine prior to incising the parts; then the abnormal state of the calcis was revealed, and one operation substituted for the other.

CASE V.—*Pirogoff's operation at the Ankle-Joint, in which Syme's had to be substituted; Recovery.*

Joseph Thompson, aged twenty-four years, admitted to Mercer's Hospital on the 22nd of February, 1858, under my

care. *History.*—Pain commenced in the instep of his right foot somewhat more than three years ago. It persisted of a dull character, in spite of the usual means tried in such cases; it gradually extended, the swelling increased, and abscesses formed on the dorsum and sides of the foot, but more beneath; these abscesses burst, and discharged abundant pus at first, but afterwards a thin sanies; for several months he could not put it to the ground, and the slightest twist or turn produced intense suffering; sweats became frequent; his appetite and sleep nearly gone, and great emaciation set in: in this condition he came to Dublin on the above date. On coming into hospital, his general health was a good deal shattered, and on careful examination of the foot through the several fistulous openings, the probe traversed very widely, and detected extensive disease in several of the metatarsal bones, particularly the scaphoid, cuneiform, and cuboid. I was not so certain of the astragalus being much implicated, and there was no evidence that the articular surfaces of the tibia and fibula were affected. I thought the calcis might be healthy, as there was neither expansion of it, nor thickening of the integuments over it, or tenderness at any point. Reasoning in this way, I determined to perform Pirogoff's amputation at the ankle; in other words, to save the calcis in the under flap; and on the morning of the 5th of March I operated after the following method. The patient being placed on the operating table, and chloroform being given, the leg close to the ankle was firmly held by an assistant; grasping the foot in my left hand, I drew a strong, large scalpel, in somewhat a curvilinear direction, across the tibio-tarsal articulation from the tip, or a little above that point of the external malleolus, upwards and across the front of the joint, to a corresponding point on the inner malleolus; the joint was laid open all through this incision; the foot was forced down with the left hand, while, at the same time, the knife divided successively the internal and external lateral ligaments; from each angle of the first incision the knife was carried down at either side to the sole of the foot, thus considerably increasing the transverse wound, and affording greater room for getting at the bones. I next separated the astragalus from the calcis, passing the knife between the bones, by a little manœuvre, in elevating, depressing, and slightly rotating with a lateral inclination the foot alternately as the knife made progress, gently and steadily introduced, and so dividing the binding ligaments between; the astragalus, thus liberated from the leg and calcis, remained adherent to the remainder of the foot by its articulation with the scaphoid; a sharp-pointed small amputating knife was then passed across the sole from within

outwards in front of the calcis, and beneath the tarsal bones, its edge being turned forwards; a considerable flap was taken from the sole, with the intention of being folded round the front of the stump, and then I easily passed the fine blade of my own saw so as to lie upon the calcis, the back of the instrument resting against the anterior surface of the upper attachment of the tendo Achillis; thus it was cut from behind forwards and downwards in a somewhat slanting manner, and then directly downwards, removing the cartilaginous covering at its anterior extremity for articulation with the cuboid. By this last stroke the foot was severed. The advantage of delaying its liberation until the calcis was sawn through cannot be over-estimated, as a leverage power was afforded throughout the operation for steadying the parts. I next dissected up the anterior flap very slightly convex from the articular margin of the tibia and malleoli, and severed these processes with the intervening cartilage and the thinnest osseous layer by the section from behind forwards with my own saw. There was the slightest obliquity in the section from behind for more perfect adaptation to the calcis. On placing the parts together, nothing could lie more evenly; they seemed as if absolutely cut out by the same measurement; and the flap which I had formed from beneath lay up most efficiently, so as to cover in the entire extent of the exposed parts: in a few words, the stump presented in every way the most perfect proportions, but, unhappily, I could not avail myself of all the advantages which the saving of the calcis holds out. My mortification was very great to find that the cancellated structure of the calcis was laden with oil and serofulous deposits, though its articular cartilages were healthy. It was to me apparent that the bone could not be saved; therefore, I had at once to substitute another operation for that which in the first instance appeared to possess many advantages, all the details of which had been so rapidly gone through, and by which such a beautiful adaptation of parts was created; presumptive evidence of a result shadowing forcibly the utility of the limb in the after-requirements of the individual. The very great practical lesson is taught here, too,—the substitution of one operation for the other, the changing of Pirogoff's into Syme's. The steps for effecting this object were very simple: the remaining and adherent portion of the calcis had to be dissected from its bed; this was easily done with a sharp scalpel; commencing above and freeing the tendo Achillis, keeping the edge of the knife close to the bone, and proceeding by short and rapid sweeps downwards; the flap formerly lifted from the sole was instan-

taneously curtailed in its proportions by a decided stroke of the knife, and then the heel-flap lay as accurately in contact, and as well fitted to the raw surface of the tibia, as if no other operation had been contemplated from the first. It may appear from this lengthened account, and from the time necessarily taken to describe these several proceedings, that the sufferings of the patient, and the operative proceedings, were prolonged. I can, however, most truthfully assure the reader that no such conclusion is warrantable. The patient lay gently asleep, insensible under the influence of chloroform; and in a few moments all that was required or considered advisable was efficiently executed. The same pressure that steadied the limb, applied above the ankle, likewise controlled the arteries; and at this stage the anterior tibial and internal plantar, all that gave out blood, were ligatured; five or six points of the interrupted suture held the flaps together, while a few long straps of adhesive plaster supported the cushion, aided by some long pledgets of folded lint placed around posteriorly and laterally, and retained by the gentle pressure of a light bandage. The dressing having been completed, the patient was removed to bed, and the limb placed in an elevated position, slightly flexed, and resting on its outer side. He quickly recovered from the chloroform, and soon after some warm wine was given, together with a full opiate. At 1 o'clock P.M. reaction was fairly established, and a slight weeping commenced from the wound; it was very trivial, but, continuing for nearly half an hour, I was sent for. I did not consider it advisable to open the wound; I therefore applied an additional bandage and support to the stump. I rolled the limb up to the knee with a moderate tightness, and steadily fixed a firm compress (a small bandage rolled up) over the tibial artery, just where it comes off from the popliteal, which was retained by a few turns of a bandage somewhat lighter than the rest. This arrangement effectually restrained the bleeding. At 6 o'clock P.M. reaction very full; ordered a draught containing tincture of opium and digitalis; and to be repeated at 9 P.M. After this I saw him; his pulse was quiet; there was no return of the bleeding; and he was free from pain.

March 6th. Had sleep through the night; all throbbing and heat and pain had left the limb; pulse rapid and weak. To have an opiate immediately; ammonia mixture; and beef-tea; draught to be repeated at 5 and at 10 P.M.

7th. Slept well; free from pain; no return of bleeding; continue opium and stimulants.

8th. This day I removed all outside dressings, leaving the

inside straps adherent; the stump looks admirably; it preserves the full temperature; no pain in it; but, passing upwards along the entire limb, particularly in the thigh, the course of the lymphatics are clearly marked in red lines. To continue stimulants, ammonia mixture, and opium draught, every third hour.

9th. On this day another complication, well-marked phlebitic inflammation; the combination giving rise to the most alarming constitutional symptoms: great depression; sudden sinking, beyond anything I have ever seen produced in so short a time; pulse scarcely perceptible, and so rapid as to defy being counted; respirations 46 in a minute; features sunken; sordes in mouth and teeth; poured in draughts with chloric ether, tincture of castor aromatic spirit of ammonia, and tincture of opium every third hour; the stomach and loins anointed with mercurial ointment and swathed with flannel; the arm-pits and groins smeared thickly with the same unguent; the affected limb covered in a similar way, and surrounded with hot flannel stupe-clothes, protected from evaporation by large pieces of oiled silk. Eight ounces of whiskey to be given in divided doses; broth and beaten-up eggs to be given repeatedly.

10th. In much the same state, almost dead; but little hopes entertained by any one of recovery. Yet in all these terrible cases produced by sudden and violent changes in the economy, the surgeon, when he understands the true source of the mischief, should never relax his endeavours, or diminish his most energetic resources while life lasts. Thus I continued all things, pouring in stimulants by the mouth, twelve ounces of whiskey by day, and a like quantity at night; injections of turpentine, assafoetida, brandy, &c., repeatedly; mercurial inunction; the most stimulating medicinal draughts every third hour; I cut off all bandages from the stump, and left merely a couple of straps to support the flap.

15th. Up to this date, much in the same fearful position, and up to the present the same powerful means were steadily continued; the respirations were as hurried, and the pulse almost a continuous wave; there was one local feature promising—some purulent discharge showed in the wound; I removed everything offensive from the limb, propped up the patient in bed with pillows, so as to relieve the venously congested lungs, and ordered stimulants of all kinds in the same amount as before, and the mercurial inunction, &c.

16th. A shade better; pulse 130; respirations 38; mercurial action established; the stimulants and food as follows:

twelve ounces of whiskey in the day, and the same at night; two quarts of beef-tea; stimulant and sedative draughts as from the first, every third hour.

17th. Still improving; continue everything; propped up by day, and placed recumbent at night.

19th. He is marvellously improved; pulse 100; respirations 36, not much embarrassed; sleeps steadily; eats six eggs beaten up, and takes two quarts of beef-tea, twenty-four ounces of whiskey in the day and night, and stimulating sedative draughts every third hour, when awake, day and night; mercurial ointment lightly applied, just to keep up and insure a continuance of its action; applied some additional support to the stump; discharge natural in consistence and quantity.

21st. Constitutional symptoms greatly amended; had to open a large abscess on the posterior surface of the leg, and about its centre; no diminution in stimulants or opiates; he requires all.

22nd. Rolled the leg from above down, to prevent, if possible, retraction of tendons, and liability thereby to abscess, and supported forwards the flap with a few turns of a bandage; better in every respect; continue everything as before; omit mercurial ointment.

26th. No alteration in the mode of dressing; continuing the opium, but for the last three days lessened the stimulants to half the quantity in the twenty-four hours; ordered chop, beef-tea, &c.

30th. Improving in every way; wounds healing rapidly, and constitutional symptoms all gone; eats, drinks, and sleeps; stimulants reduced to four ounces in twenty-four hours.

April 3rd. Greatly improved constitutionally, and but little discharge from the wounds; abscess healed.

20th. Since last report he was seized with sudden and unaccountable prostration, loss of appetite, &c.; but after the second day, by free exhibition of stimulants, he again rallied, and is now dressed and up every day; wound just healed.

May 12th. Stump just healed, and able to go on crutches into the garden.

June 2nd. A large abscess formed beneath the tendo Achillis; a free incision was made, which discharged its contents; some caution was requisite, as the layers of fascia had to be freed over the line of the posterior tibial artery. On the 29th I had to lay open another, near the insertion of the tendon at the back part of the cushion. On July 9th all was nearly healed; on the 21st he went to the country. Thus this most embarrassing case was brought to a satisfactory termination. Nothing could possibly

be more unpromising from first to last : the most fearful complications occurred, for there can be no doubt that pyemia was set up after the establishment of the lymphatic inflammation. Even towards the resolution of the case, there were irritant cough and slight purulent expectoration, with all the characteristic fetor of the secretion. This fetor was even recognised by myself prior to any trace of the matter in the ejected sputa. The physical examination of the chest gave evidence of absolute dulness at one part, the upper portion of the left lung ; and after the expectoration was established, as the case improved, it gradually subsided and ultimately disappeared altogether. I have no doubt upon my mind that a purulent depot had formed in the part of the lung specified, and ultimately opened into a bronchial tube, and was thus got rid of. Mr. Tagert, who carefully watched this case with me, coincided in the same view. To the mercury here, I think, must be ascribed the great and salutary check to the inflammation in the venous structure, the paralyzation of the whole capillary system. This was materially empowered by the large and repeated doses of opium, while the *inordinate quantity of stimulants* of various kinds was effective in promoting the heart's action, and arousing the dormant nervous centres.

I have beside me a letter written by this man on the 27th of October, and he states " that a little matter yet comes off, from the opening on the outside, when pressed upon ; the stump is gradually increasing in firmness, especially during the last fortnight. I have not walked upon it yet. My health and appetite are very good." The patient likewise sent me a cast of the stump ; it is perfect in shape, &c. (See Plate V., Fig. 2.)

Such, then, is the history of these two cases, in which I performed Syme's operation ; and upon serious reflection I have no reason to alter the opinion which I expressed so many years ago, as to its not being so applicable to the humble labourer and artisan, as to the wealthy sufferer.

If anything could make me waver in this view, owing to some of the comparative benefits obtained in the instances I have adduced, it is entirely removed by the altered sentiments of Professor Fergusson, for I have already quoted his favourable notice of this operation as expressed in his Lecture on the subject, at the time when mine was condemnatory of the practice. It is right that the matured opinion of so great a surgeon should be fairly put, upon a question of such great importance ; and the way in which it can best be done, I conceive, is

by reference to the latest edition of his *Practical Surgery*, a book that should be in the hands of every surgeon. In the third edition, published October, 1852, we find that subject dealt with in the following terms, at page 489:—"The operation proposed and performed by Mr. Syme does away with such objections, however; and, in so far as I can judge, is one of the greatest improvements in modern surgery, as regards the subject of amputation." And at page 491:—"I have now had considerable personal experience in this operation, and do not hesitate to give it my strongest recommendation." How different the views expressed in the last edition, the fourth, published in October, 1857! At page 487:—"I have now had considerable personal experience in this operation, and have seen some excellent results from it; but I regret to state that the early impressions I had formed of it, as expressed in the last edition of this book, have been greatly modified. What with the violent inflammation extending up the leg, sloughing, secondary hemorrhage, death immediately dependent on the operation, tardy healing of the wound, and defective condition of the stump, from languor of circulation and tenderness, so that it could not be pressed upon or made useful,—I have formed a most unfavourable impression against it."

It appeared to me that many advantages presented in Pirogoff's operation, and therefore I adopted it, not being satisfied with Syme's, and yet wishing above all things to preserve the elastic cushion of the heel. I shall insert here Mr. Wells' translation of the different steps of Pirogoff's operation, from his own book:—

"I commence my incision close in front of the outer malleolus, carry it vertically downwards to the sole of the foot, then transversely across the sole, and lastly, obliquely upwards to the inner malleolus, where I terminate it, a couple of lines anterior to the malleolus; thus all the soft parts are divided at once quite down to the os calcis. I now connect the outer and inner extremity of this first incision by a second semilunar incision, the convexity of which looks forward, carried a few lines anterior to the tibio-tarsal articulation. I cut through all the soft parts at once down to the bones, and then proceed to open the joint from the front, cutting through the lateral ligaments, and thus exarticulate the head of the astragalus. I now place a small narrow amputation saw obliquely upon the os calcis behind the astragalus, exactly upon the sustentaculum tali, and saw through the os calcis, so that the saw passes into the first incision through the soft parts. I separate the short

anterior flap from the two malleoli, and saw through them at the same time close to their base; I turn this flap forwards, and bring the cut surface of the os calcis in apposition with the articular surface of the tibia. If the latter be diseased, it is sometimes necessary also to saw off from it a thin slice with the malleoli."

I think it will be found that greater facilities of cutting the bone, disengaging the parts, will be afforded by the method which I have laid down, rather than that conveyed by what I have transcribed. .

According to the same translation, Pirogoff claims for his method the following advantages:—

"1. The tendo Achillis is not divided, and so we avoid all the disadvantage connected with its injury.

"2. It also follows that the base of the posterior flap is not thinner than its apex; while the skin on the base of the flap remains united with the fibrous sheath of the tendo Achillis.

"3. The posterior flap is not cap-like, as in Syme's method, and its form is therefore less favourable to a collection of pus.

"4. The leg after my operation appears an inch and a half (sometimes even more) longer than in the three other operations (Syme's, Bauden's, Roux'), because the remnant of the os calcis left in the flap, as it unites with the inferior extremities of the tibia and fibula, lengthens them by an inch and a half; and—

"5. Serves the patient as the point of support."

Several cases are given by Pirogoff, proving the success of his method. In allusion to the frequent abscesses occurring after any of those amputations at the ankle-joint, he says:—"I fear nothing so much as this, namely, when the belly of the muscle contracts, and draws up the tendon divided, or half destroyed by suppuration, out of the sheath. I am convinced that the fixing of the tendons before and during the operation by methodical pressure, and the continuous maintenance of the limb in one and the same position by the plaster bandage, may contribute a great deal towards the successful result of these operations."

I am indebted to Mr. Wells' translation, likewise, for Pirogoff's concluding observations relative to three cases which he minutely details; they offer many points for reflection, and, practically, are of value in the selection of cases:—"It was also worthy of remark, notwithstanding the suppuration and the considerable gravitation of pus into the flap (in the third case);

notwithstanding the softness and fatty degeneration of the os calcis, which could be cut with a knife (in the second case): still the remnant of the os calcis united firmly with the tibia and fibula. Lastly, one of the cases (the third) proves that the exarticulation at the ankle-joint after my method, at least in children and young people, may be undertaken even in cases of diseased ankle-joint, provided disorganization has not extended too far over the soft parts about the articulation. In the boy in the second case, I found pus in the capsule; during the operation the cartilages softened and decayed; the ends of the bones also softened and in a state of fatty degeneration: yet the result of the operation was most successful." We have a very favourable report of the operation published in the *Lancet*^a by Mr. Croft, Assistant Surgeon to the "Dreadnought." It has been performed six times—four recoveries, two deaths; one from granular disease of the kidney, the other from secondary deposits of pus in various joints. In all the four successful cases there was supuration along the tendons of the leg, but no exfoliation of bone. The posterior part of the os calcis was united firmly with the tibia generally in about three weeks, but in one instance in twelve days. Mr. Fergusson, in the last edition of his *Surgery*, alludes to a successful case performed by Mr. Ure of St. Mary's, and gives a sketch of the stump resulting after a similar operation executed by Mr. Partridge, upon which he observes:—"The child, when I saw it a few days ago, was walking nimbly, and with a halt scarcely to be detected."

It is certainly difficult to reconcile the successes of the operation in the hands of the great Russian surgeon, its inventor, with the intelligence "reported by Messrs. Mouat and Wyatt, in an official paper addressed to Inspector-General Sir John Hall, that Pirogoff has modified his operation to that of Syme"^b. However, be this as it may, now that we have got hold of it, we will not readily let it escape without a fair trial. I conceive myself that it offers one great advantage over any other proceeding that could possibly be devised in this situation, one which I think must secure a stump capable of any hardship, and that is, because the heel cushion, the great characteristic of Syme's operation, is preserved in its *normal attachments* to the calcis, while the slicing of the upper surface of the bone permits of a ready union being established between it and the cut surfaces of the tibia and fibula; a solid bond, bone grown into bone, or a fibro-ligamentous structure of such

^a February, 1858.

^b Fergusson's *Practical Surgery*, Fourth Edition, p. 487.

shortness and density as to resist all violence or displacement. I look upon the operation, altogether, as a beautiful application of our art. No doubt, some difficulties may arise during the process necessary to cure: abscesses may pass along the tendons and up the leg, and so they have been proved to do after Syme's operation; by careful padding and bandaging from above downwards, as I have laid stress upon myself, and as mentioned by Pirogoff, such casualties may be prevented or fairly managed. The risk as to life is not greater than in Syme's operation; and allusion need scarcely be made to the difficulties in performing either. The chance of the heel-flap dying, or of the divided calcis perishing for want of supply, need not be dreaded, for the *rete calcaneae* is not interfered with, the interchange of blood is sufficient for both; nay more, it will afford its quota of vitality towards the union surely to be brought about with the tibia and fibula. How often does the hospital surgeon see portions of the calvarium removed with the scalp, and how frequently does the military surgeon see the same from sabre wounds; yet each is conversant with the fact that it is only necessary to lay back the scalp and the piece of bone from whence it was sliced away, and union will surely follow, either by first or second intention: so with the calcis, it is undisturbed from its external and surface supply, therefore will not perish. The length of the limb gained by this operation must not be lost sight of. In the four cases given by Mr. Croft, the difference in length between the foot operated upon and the sound foot was never more than three-eighths of an inch; and in Mr. Partridge's case, as before mentioned, "the child was walking nimbly, and with a halt scarcely to be detected."

Before concluding, however, I cannot, in justice to the subject of amputation at the ankle-joint, pass over the most interesting cases published by Mr. Oliver Pemberton, Surgeon to the Birmingham General Hospital. His views are quite in favour of the proceeding; and, to carry out the principle "*siquid novisti rectius istis candidus imperti*," I must make mention of the case of a boy in which I assisted the late Dr. Bellingham in removing the foot at the ankle-joint, after Syme's method, about two years and a half ago. The patient was aged thirteen years. He has been with me repeatedly during the last five months for a carious state of two of the ribs, so that I have had ample opportunities for observing him. Though he has been imperfectly walking upon the stump for the last nine months, assisted by a stick, yet now he is able to do so without

any artificial aid. It is only four months since all the sinuses have healed up; they were continually forming in the lower third of the leg and at the junction of the margins of the flap. From the very first it was difficult to keep up the flap to its berth; however, time has done much, and now he is able to walk upon it, assisted by a simply contrived boot, which conduces to the proper length of the limb, bears off unequal pressure, and protects the surface from injury; though the well-formed cushion fulfils its part, frequently matter oozes out of one of the several apertures above the stump and along the limb. In Plate V., Fig. 3, is most accurately represented the condition of the part. I took the cast myself from which the engraving has been so beautifully copied, so that I may attest the truthfulness of the picture. The several apertures on the front view are naturally exhibited, while many behind cannot be seen; some are so recent, as to be even now only scabbed over: yet, taking all things into consideration, I would say this case speaks, on the whole, favourably for Syme's operation. Though considerable time has passed by, yet this is not to be looked upon as a fatal disparagement; the grand object is gained, the patient can get about, and earn his bread with the limb.

CASE VI.—Excision of a large portion of the lower Jaw in a boy aged seven years, for an osteo-vascular tumour; Intermediary hemorrhage after operation considered; Perfect recovery.

Oliver Bond, aged 7 years and 3 months, was admitted to Mercer's Hospital September 28, 1858, with a tumour, about the size of a large walnut, springing from the inferior maxillary bone. Fourteen months ago the boy was constantly complaining of aching pain in the centre of the body of the lower jaw, on the right side. There was some fulness of the bone and tenderness of the part around, both within and without, two of the molar teeth corresponding to this site. The pain frequently assumed a dull kind, not so acute, accompanied by great tenderness, with a constant desire to rest the face upon anything that offered for support. The teeth were in no way diseased; they were hard, white, and covered with enamel. After the continuance of this pain for about two months, the teeth loosened, and as they gradually became so, the pain was mitigated in its character; ultimately they were shed, being gradually thrust up by an apparently fleshy growth springing from beneath them. This growth, though hard and firm as bone

to the touch, yet was covered by a fleshy surface. Gradually and slowly it increased, with occasional hemorrhages from its surface. At some times it was exceedingly prone to bleed, and frequently the friends of the child had difficulty in arresting it; however, by the application of lint, steeped in turpentine, it was stopped on two occasions.

The following was the state of the child when received on the above date under my care:—

He was a pale, delicate-looking little creature—the waxy colour being no doubt produced from the repeated small losses of blood. He suffered at times a more acute pain in the jaw than at others, which increased considerably on masticating his food, as then the growth was pressed upon. On simple inspection of the face, the deformity was not very remarkable. A rounded, even tumour rendered the right half of the lower jaw more prominent than the left, particularly about its centre. On opening the mouth widely, the extent of the tumour could be seen in its entirety. The body of the bone for more than an inch was engaged; its walls were expanded; and, springing upwards, a solid osteo-vascular tumour appeared, about the size of the largest walnut. Now the expansion of the jaw corresponding to the site named was equable, as great in the inside as on the outer, and though the under rim or edge of the bone was not distorted, yet it was equally apparent that the origin of the morbid product had its nidus, its birth, and its growth deep in and from the osseous structure of the jaw. As it passed upwards, it gradually expanded until it measured an inch and a half, incorporating with itself the gum. The tumour, having passed above the range of the teeth in front, and behind it about one quarter of an inch, became quite flattened on the surface, while its margins were rounded off. Its surface presented other peculiarities. It was uneven, mammilated, of elastic, dense structure, compressible to a moderate extent, while its walls were osseous and perfectly unyielding. The coloration of the tumour deserves notice. All the superficies of the elastic mammilated part was highly vascular, being of a deep purple hue, while in others arterial vascularity predominated. The least roughness in manipulation, or undue pressure on it, caused breach of surface and a ready effusion of blood; and thus, during the act of mastication, bleeding often was a consequence. The handling of the tumour in itself, or the compression of it in a moderate degree, gave no pain, save when applied to its most elevated surface; neither did pain set in or lurk in it as a consequence.

As to the propriety of removing this tumour, no second opinion could be entertained. The dangers and annoyances already noticed, consequent upon its growth, called loudly for such a proceeding. For the accomplishment of this object, two operative procedures instantly suggested: the one, a partial cutting out of the bone, together with the tumour; the other, the resection of the entire body of the jaw with the morbid growth. The one, a scooping operation, cutting away the tumour with the alveoli, and the surface of the jaw from which they sprung, leaving the under surface and more compact portion uninjured in its entirety. No doubt, in the smaller forms of epulis, and in certain other mild kinds of tumours, such a proceeding would be best suited and greatly to be extolled—in fact, it should be the practice, and from which no deviation would be admissible; but, as in the present instance, where the structure of the bone was extremely involved; when it was widely expanded; when none of the original healthy, dense tissue of the bone remained, save along the lowest part of its under margin; when the nidus of the growth was, as it were, buried deep in the interior of the bone; and when from this point it started its slow, steady, disintegrating, progressive action, until it loosened and forced out the teeth, and ultimately spread in that direction where least resistance was offered—I believe, in such a state of things, the total removal of that part of the jaw to be imperatively demanded. Again, it is only by so decisive a proceeding that an immunity from return could be guarded against.

With the conviction of the correctness of these views as applied to the case detailed, I executed the following operation on the 4th of August:—The boy was rolled in a large sheet, mummy-wise; he was seated upon a high chair, with his head resting against the breast of an assistant. Standing in front of the patient, I transixed the lower lip, in the mesial line immediately beneath the red border, with a straight, sharp scalpel, carrying the knife directly downwards to the base of the chin; the vertical incision having been completed, the knife was next laid on the cheek, just in front of the facial artery, and a little above the lower edge of the jaw; being struck at this point down to the bone, it was rapidly drawn forwards until it met the lower angle of the wound first made, and their junction was most accurate; blood started from the furrow as the knife passed along, but it was only the issue from minor vessels; this flap, a small one, was quickly freed, and elevated from its attachments, but it was difficult to hold it out

of the way, and, sooner than be interrupted, or prolong the operation for a moment more than was requisite in this little, tender patient, I completed the section of the red border of the lip. The division of this part facilitated matters extremely, permitting a free and extensive elevation of the flap and cheek, and according a ready axis to the division of the bone, which was completed after the following method:—The body of the bone was deeply cut with a fine saw, through its compact lower margin, just external to the incisor teeth, and a short-jaw-bone forceps completed the solution of continuity. I next, with a scalpel, prolonged the horizontal incision backwards to the angle of the jaw, caution being taken to sweep the knife in a slightly curvilinear direction while making the section of the facial artery. This manœuvre prevented retraction of its lower or cardiac end; and the vessel was at once taken up and ligatured; the upper flap was more posteriorly set free, and the bone being detached from the soft parts beneath and behind its angle, its section was completed behind the last molar tooth by the application of the saw and forceps, as in the first instance. The isolated portion of the jaw, together with the tumour, was then carefully liberated from the soft parts, the knife being kept close to the bone, particularly below and behind; during the incisions requisite for its detachment, the index finger of the left hand rested beneath the blade of the knife, thus effectually shielding the larger vessels so superficially placed at this tender age of childhood. I wish particularly to emphasize the practical value of the latter observation. The part being thus removed, but one small artery in addition required ligature, and little blood was lost during the prosecution of the dissection. The small vessels ceased to bleed after a few seconds, and the dental, having thrown out two or three jets, retracted and likewise stopped. Seeing that no further flow was to be apprehended, some wine was given; lint was placed in the gap from whence the bone was excised, to prevent the bones falling together, and then the parts were brought together and retained by three points of the interrupted and three of the twisted suture. The latter were placed in the following order,—one close to the maxillary vessel, another through the angle of the flap, and the third beneath the red border of the lip; two points of the twisted suture were placed midway in the interspaces between the needles, and the third on the upper surface of the lip. Thus the entire was supported, the section from one end to the other lying in the most accurate apposition. There was no retraction of the

tongue to cause uneasiness. The child was next removed from the operating theatre, and placed in bed, almost supported in the sitting position, any deviation from which produced distress in respiration, owing to the tongue inclining or falling backwards. In three hours reaction was nearly established, and a sharp intermediary hemorrhage set in; blood flowed quickly, of a bright arterial colour, several large coagula were formed by what escaped. I mention this fact merely to show that a considerable quantity had been shed; however, when I arrived at the hospital, the bleeding had ceased. On inspection of the case then, it was clear that a good deal of blood had been lost, both from the quantity produced and the feeble pulse of the little patient; cold sweat and restlessness also indicated the amount to have been considerable; a large, firm coagulum filled a part of the space from which the tumour had been cut out. I sat beside the child for nearly an hour, waiting to see whether there would be any recurrence of the bleeding, but there was none; bladders filled with ice were applied to the neck and cheek, and the bed-clothing was reduced merely to the sheet; directions were given for cold beef-tea to be administered in spoonfuls, and all drinks for the relief of thirst to be iced. After this the child went on favourably up to night, when I saw it late; there was no return of the bleeding, but marked restlessness. I had administered six drops of tincture of opium, with directions to be repeated in four hours if necessary. After the first dose the child became composed and slept, and not until 6 the following morning was it requisite to administer the second dose; the child, having taken some nourishment, went off quietly to sleep, and did not awake until 9 o'clock A. M., the hour of my visit.

August 5th. No return of bleeding; the child freely takes nourishment, and quickly composes itself to sleep again.

In reference to the hemorrhage, which occurs frequently after operation, and which might be termed intermediary, an admirable example is afforded in this case, and it inculcates a good lesson—how the surgeon must be cautious in unwarrantably meddling. Intermediary hemorrhage takes its place between that occurring as the result of accident or wound inflicted by the surgeon—hence the term primary; and that arising at a more distant period, as the result of ulceration or sloughing, secondary bleeding. Now the intermediary hemorrhage may take place at any time between these two periods, but the most frequent is that when reaction is fully established. When reaction passes beyond the bounds to which it should be limited, then

the rush of blood which passes to the injured part finds its escape by those minor vessels which, while the patient was under the apprehension of fear, and the depressing agency of the nervous shock of operation, refused to bleed even on section, and consequently eluded the ligature; but afterwards, when the heart's action is restored, when the circulation is established, heat generated, the feeble retraction and contraction of these vessels yield to the impulsive current from above, and thus the flow. Now this bleeding continues for some time, and even briskly, but it will generally cease of its own accord; and if it has done so, the surgeon should not meddle with the clots or dressings, under the presumption that by so doing he will prevent a repetition of the mischief. No; in those cases there will very seldom be any return of it: the engorged vessels have emptied themselves, the reaction is lowered, the circulation is more feeble and balanced, retraction and contraction of the divided vessels again takes place; and further, the very production of the clots becomes gradually and effectively a temporary obstacle to the pouring out of the fluid; a few hours longer, and these vessels are permanently sealed. So much as to the management of the case when this intermediary hemorrhage has ceased. But now let us take the other view, in which this intermediary hemorrhage may present itself—where the flow of blood is persistent—where it has resisted, even for a short time, the application of cold (ice), astringents, &c.—when in considerable quantity, or when even it is but afforded triflingly in instances where the patient has been previously greatly emaciated and run down—I have no hesitation in saying it would be the duty of the surgeon not to tamper any longer with the case, but at once to remove all dressings, sutures, &c., and make diligent search to secure the vessels, to stay the bleeding.

This intermediary hemorrhage has occurred to me in many cases, after amputations, resections, and in two instances after lithotomy in the child; yet it did not seem, as well as I can remember, to act in an unkindly way, to render more tedious the recovery, or mar the result. In concluding my remarks upon this casualty, I would wish it to be understood that I acted strictly in accordance with the above tenets.

7th. Union effected throughout the entire of the cheek wounds; removed the stitch in the red part of the lip, and the line of incision was almost imperceptible; suffered the other ligatures and the needles to remain; patient free from all pain, and partakes freely of nutritious broth, crumb bread, and abundance of milk.

9th. Removed the needles and stitches; I suffered them to remain thus long because not productive of the slightest irritation, and they yielded such an efficient protection to the recently united parts, against any injury from the unguarded movements of the child. The patient from this time rapidly improved in health, being now able to eat abundantly, which it was prevented doing prior to the operation. On the 12th the ligature of the facial artery was cast off, and on the 14th the track through which it was brought out upon the cheek was obliterated. On the 15th the child was up and running about the ward, and on the 25th was dismissed cured.

The improved condition of the child when it was brought to see me at the hospital in a few weeks later, was most striking: he was large, fat, and sprightly. The accompanying drawing is an accurate representation of his appearance, and a most excellent likeness. (See Plate V., Fig. 4.) The extent of bone taken away, and the form of the tumour, are each depicted of full size. (Fig. V., Plate 5.)

CASE VII.—Excision of the Metatarso-Phalangeal Articulation of the great Toe; Recovery, with perfect use of the foot.

In speaking of this operation, Professor Fergusson, in the last edition of his *Practical Surgery*, says at page 445:—"It happens sometimes that the disease [caries] is limited to the articulation between the great toe and its metatarsal bone. In such an instance, Professor Pancoast has employed resection of the joint, a proceeding which, so far as I know, has never been done in this country; it is said to have also been performed by Professor Regnoli of Pisa."

Excision of the metatarso-phalangeal articulation has been most successfully performed by M. Fricke; and Kramer excised the anterior extremity of the first metatarsal bone in 1826, for a compound dislocation. M. Josse^a speaks of a case in which the luxated head of the first metatarsal bone was excised, and the movements of the great toe after were preserved. M. Blandin in one case excised the anterior half of this bone for a spina ventosa; in another case he removed the three anterior fourths of it^b, being an inch and a half in length; while M. Jobert has removed the anterior half for caries. Roux has likewise successfully performed this operation; and Fricke has been no less fortunate in removing the phalangeal articulation of the

^a *Journal de Médecine et de Chirurgie*, p. 352.

^b *Journal Hebdomadaire de Médecine* 18th October, 1828.

same member in another case^a, and M. Champion^b, has twice excised the posterior extremity of the first phalanx of the great toe, in a state of caries, and in both instances the patients recovered perfectly. Meditating upon these cases, and emboldened by their success, I, too, achieved my object as satisfactorily as could be anticipated or desired.

Mary Bryan, aged 21, admitted to Mercer's Hospital, November 6, 1857; a very interesting-looking girl, but of purely scrofulous diathesis. Her complaints as to the hopes of relief were incessant, she having suffered for such a length of time, and without receiving any material advantage. Her hopes were greatly shaken, and, being in a marked way dependent upon her labour as a means of support, the anxiety that she endured as to the chances of a permanent benefit was most painful to witness. She dates a well-marked history of the case to have its commencement so far back as a period of five years; at this time she remembers that a slight injury, a bruising of the dorsum of the foot, gave her great uneasiness; the part became immediately swollen, intensely painful; however, by leeching and perfect repose, the truly great suffering was relieved, and counter-irritation, blistering, &c., completed the removal of pain. Thus she got over this inflammatory attack consequent upon the injury, no doubt modified and magnified by the constitutional taint, the idiosyncrasy to perverted action; but again in the two successive years, additional mischief supervened, but of a slow character; gradually and steadily the parts thickened, with a dull, heavy, tingling pain, sometimes absent altogether, at other times sufficiently acute to prevent sleep. During the past year, an abscess formed in the dorsum of the foot, and discharged itself; matter flowed freely at first, and steadily oozed after, and even up to the present time, that of the above date of her admission. Various means were tried to check the discharge, to cure the part, before she placed herself under my care; but she was hurriedly compelled to do so by a sudden increase of swelling, enlargement, pain, incapacity to move, and in fact she was so bad that she had to take to bed, where she had remained three weeks previous to my seeing her.

On a careful examination of the foot, it became apparent, by a cautious use of the probe, that the anterior part of the metatarsal bone of the great toe, together with the phalangeal articulation, was involved in destructive caries. I resolved at once to liberate the parts, and cut out the diseased bone, taking

^a Velpeau's *Operative Surgery*, vol. iii., p. 816.

^b Thèse, p. 93. 1815.

the entrance through the sinus as my guide; a director was passed posteriorly, and the parts freely slit upon it; so in like manner the instrument was turned forwards, and a similar division made at once down to and along the track of this carious bone. The edges of the wound were drawn laterally or asunder by copper spatulæ, and thus a free access was afforded to the diseased bone; the anterior third of the metatarsal bone was hopelessly affected; so I dissected around it, and, finding the articular surface of the phalanx, where in contact with the metatarsal bone, stripped of its cartilage, I clipped off with a bone forceps the obnoxious parts, and having thus, as I conceived, taken away all, I cut across the extensor tendons to prevent any cocking up or distortion of the ungual phalanx. The entire was then steadied in a suitable splint, and bandaged so, a few stitches having been previously inserted so as to retain the flaps in accurate contact. The entire healed without any troublesome sinuses or annoyance of any kind, and the young woman was walking upon the limb on the 20th of December. Six weeks after the operation she was dismissed from the hospital; and a few days later she returned to service, her occupation being that of waiting upon ladies. I have frequently seen this young person since, and certainly the result of the operation is most gratifying: months have passed now, and she has not suffered the slightest pain or inconvenience in it, though constantly moving about; the only disfigurement is, that the length of the great toe is diminished; the intervening tissue, fibrous, dense, almost cartilaginous, between the first phalanx and the point of section of the metatarsal bone, has retracted the phalanx, and thus shortened the internal line of the foot, but the section of the tendon has effectively acted in preventing its elevation; when a boot is put on, with a small morsel of cotton in front, it would be impossible to observe any difference between it and the sound foot. I have also had the boot constructed for her with a thin steel plate, half an inch in breadth, running along the sole, corresponding to the site of the metatarsal bone and great toe, affording the most steady, efficient, and complete support, and at the same time sufficiently springy to allow the arch of the foot to fulfil the objects of its construction.